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LUNG ABSCESS AND BRONCHIECTASIS

A CLINICAL AND ROENTGENOLOGICAL STUDY OF ONE HUNDRED CASES

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WE are yet in the dark as to the essential conditions which determine suppuration and gangrene of the lung. The various suppositions which invoke a predisposing cause in the lung of the patient are unsatisfactory. More likely it is some special quality of virulence inhering in the infecting micro-organisms which give rise to a persisting type of lung inflammation which on the one hand may usher in a rapid abscess formation with necrosis, and on the other lead to a slow induration of the lung with the gradual formation of multiple bronchiectatic cavities. The frequent occurrence of putrefaction in these cases makes it very probable that the anaerobic organisms which gain entrance to the lung by the aspiration of foreign bodies or infectious material from the mouth during operations or in states of inanition, provide the determining element in many cases.

Although we are thus poorly informed as to the etiology of lung suppuration we are somewhat compensated for this deficiency by its more complete pictorial representation (if I may use the term) afforded by consecutive roentgen examination.

Let us study the sequence of events in a case of postoperative lung abscess. In my experience this most commonly follows tonsillectomy, and only when the patient is fully under the influence of ether. There can be little doubt that these abscesses result with such relative frequency from the aspiration of the infected plugs in the tonsillar crypts which are squeezed out when the tonsil is grasped in the forceps.

The lodgment of such a plug in a bronchus gives rise to a pneumonia varying in extent from a small patch up to a whole lobe, with the usual accompanying symptoms. At the point of lodgment of this septic plug, the anaerobic organisms set up a destructive inflammation of the bronchus with the formation of a gangrenous bronchiectatic cavity of varying size. It may be small and single, or large and multiple, so that it is readily visible with the roentgen ray. Such a cavity usually lies embedded in the infiltrated lung, and by its presence and the putrid secretions which it engenders maintains a chronic irritation of the lung about it. This in a short time results in an indurative pneumonia which is no longer capable of spontaneous resolution. Such a case is illustrated in Fig. 1. Three months before,

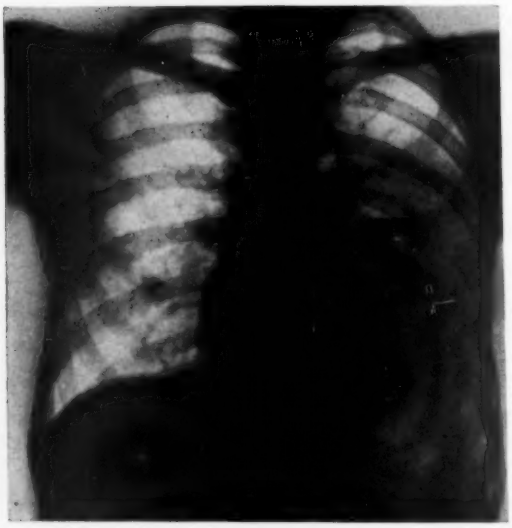

FIG. 1.

this patient had his tonsils removed. After the usual symptoms there has developed a persistent infiltration surrounding a

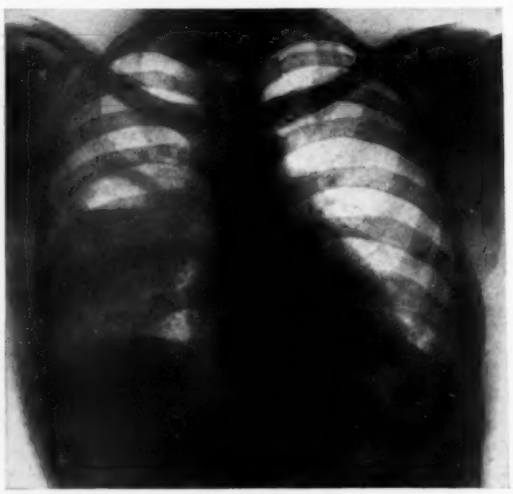

FIG. 2.

cavity in the right lower lobe. On the other hand in another case after the passage of a few weeks only, a much larger cavity has resulted. (Fig. 2.)

Let us follow the further course of such abscesses, for the present confining ourselves to the postoperative variety because they come to our attention earliest and at a time when they may undergo rapid changes. They either go on to a complete cure in a considerable percentage of the cases, or they improve to a certain extent and then suffer repeated relapses. Observe Fig. 3. Within one month a large cavity 1½ inches in diameter has

FIG. 3.

developed within a pneumonic area of moderate extent. Within another month both the cavity and the pneumonia have disappeared and only a few strands of fibrous tissue remain as a relic of the inflammatory process (Fig. 3a). It is remarkable that a cavity of this size can

FIG. 3a.

so completely disappear in so short a time, but such rapid restitution to the normal is characteristic of the healing of lung defects when the infection has subsided. If the necrotic walls of the cavity slough out and are expectorated, the anaerobic infection dies out. It no longer exerts its irritant effects on the lung; the pneumonitis subsides, the lung once more becomes air-containing, and as it expands automatically obliterates the cavity. A similar outcome occurred in the case illustrated in Fig. 4. This is the same case as Fig. 16; there is a complete disappearance of the

FIG. 4.

cavities and the infiltration is undergoing a rapid absorption. Apparently a large pneumonic infiltration can regress as readily as a small one, the only prerequisite being the sloughing out of the gangrenous area.

Unfortunately such a desired result occurs only in cases of short standing. A persisting irritation soon leads to fibrosis, which brings in its train rigid membranous cavity walls that will not collapse. Fig. 5 illustrates a case whose inception dates back eight months. The abscess has been well walled off by a definite membrane and its effects are no longer, at least for the present, propagated into the lung. Hence there is no pneumonic infiltration. But this putrid cavity, communicating with a bronchus, exists as a menace to the rest

FIG. 5.

of the lung whose integrity it constantly threatens. Such an abscess cavity is no longer capable of spontaneous healing. Sooner or later, the overflow from this cavity will infect neighboring or distant

FIG. 6.

healthy lung tissue and the disease will take on renewed activity.

An even more unfavorable condition for spontaneous or operative cure exists in a

case of the type shown in Fig. 6. Here not only has a cavity persisted but there is an induration and consolidation of the right upper lobe about it. The result of this is a progressive round cell infiltration, fibrosis; the terminal bronchioles are strangled and secondary bronchiectatic cavities develop. Usually these secondary cavities are much smaller and are not visible on the plate. In fact, in the great majority of the cases only one fairly large cavity is visible on the roentgen plate; on the operating table or on autopsy additional macroscopic cavities are usually found and also microscopic dilatations of the bronchi. Such cases can only be cured surgically by eradicating the whole diseased lobe, by a lobectomy, whereas the cases of solitary abscess without infiltration may be effectively treated by incision and drainage.

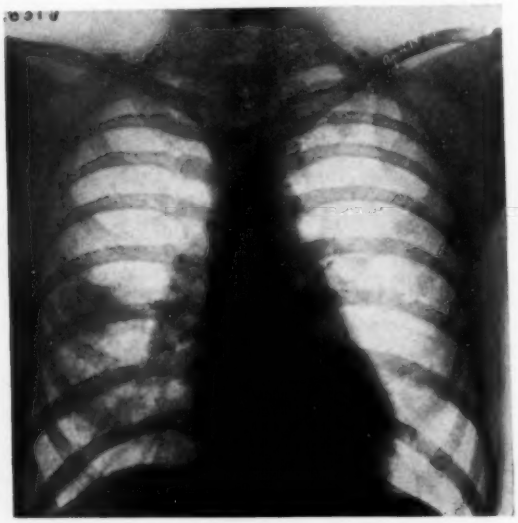

FIG. 7.

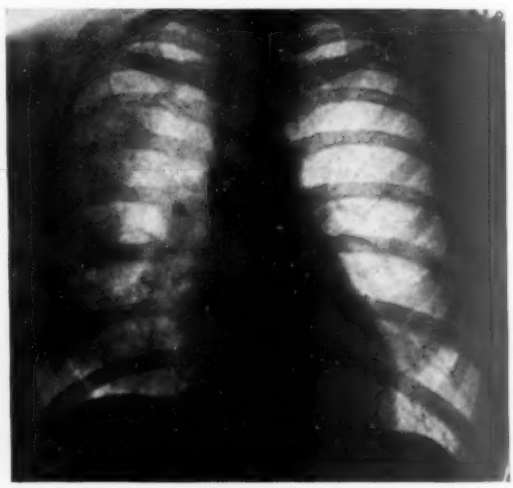

FIG. 8.

It will thus be seen that the roentgen ray affords a convenient and exact method of following the evolution of suppurative lung conditions. I am tempted to say that it is the only reliable method, for the following reasons. To assert that a case is cured because the clinical symptoms have abated or subsided is unsafe. A study of the history of these cases shows nothing more clearly than the frequency of remissions in the symptoms and the physical signs. In such a remission, which is favored by residence in the country, both symptoms and physical signs may be absent or they may be so slight that their importance and significance are not recognized. Under such circumstances the roentgen examination will always show evidence of disease. I will not speak of the cases in which the roentgen plate discloses one or more cavities that have eluded physical examination, which is not charged to the lack of skill of the examiner. More commonly there is found only a small area of pneumonic infiltration which has persisted after an apparent cure. Ill-defined, and inaccessible to ordinary methods of examination, such a focus of disease will flare up under ill-understood unfavorable conditions and reproduce a former extensive involvement of the lung. To illustrate, Fig. 7 is that of a patient who apparently recovered completely from an acute abscess. There was no clinical evidence of disease and the patient felt so well that she was with difficulty kept for observation. The plate, however, revealed the small area of infiltration in the right lower lobe. Observe its potentiality for harm. Within a week, the infection renewed itself and encompassed a considerable area of the

contiguous lung, and a cavity has formed. The symptoms also have all returned and the patient is acutely ill with all the symptoms of a gangrenous abscess of the lung (Fig. 8). Now, such a small pneumonic area may elude the most careful physical examination. In fact, one is struck by the paucity of the physical signs which even a large area may produce. In announcing a cure, therefore, of a lung abscess, not only must the clinical symptoms and signs have subsided, but all roentgen evidence of disease must have disappeared.

Experiences such as that just recounted, make it probable that the frequent exacerbations which mark the course of many lung abscesses owe their origin to an extension of existing foci of disease. Conditions for their occurrence are most favorable when there exists a large cavity full of secretion communicating with a bronchus. The spilling over of the contents of this cavity or their expulsion in the act of coughing will inundate a near or remote portion of the bronchial tree and thus at a stroke inaugurate a widespread disease. Thus in Fig. 9 it is very evident that the pus from the large cavity in the upper lobe has infected the lower lobe on the same side and has produced an extensive pneumonia. Again, such a cavity may secrete highly toxic material which, spread broadcast throughout the lung, leads to a disseminated broncho-pneumonia and a rapidly fatal putrid intoxication.

A second large group of suppurative lung conditions is that which follows pneumonia or influenza, or is a sequel of an attack of bronchitis. In a general way it is possible to distinguish two types of abscess conditions in these cases. In the one the sequence of events after pneumonia is very similar to that encountered in aspiration abscesses. Because of the early onset of gangrene with cavity formation these patients come under observation at an early date, usually during the first few weeks of their illness, and I have thus been able to determine that they differ in no wise from the previous group. In a second, larger group of cases resulting from pneumonia the patients are usually seen some months after the onset of their illness. They do not appear to become gangrenous until later and therefore many of them do not exhibit a large cavity. These cases are very insidious and go on to a progressive fibrosis with the development of numerous bronchiectatic cavities. These are the cases which commonly originate in a so-called attack of grippe, in which the transition from an acute

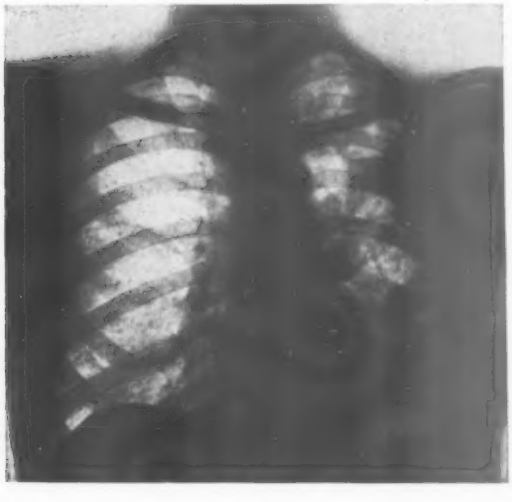

FIG. 9.

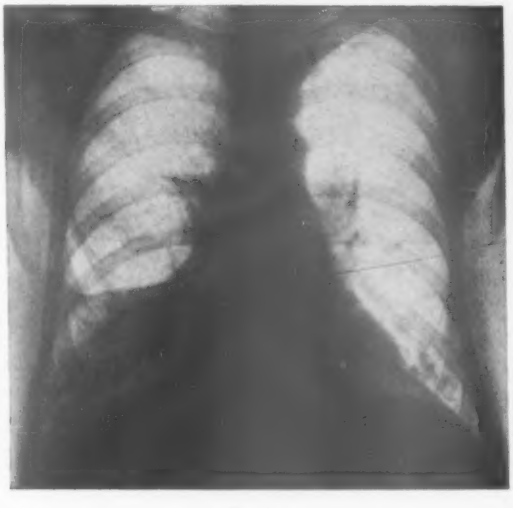

FIG. 12.

respiratory infection to a chronic lung abscess is almost unnoticed. The roentgen observation of such cases is very instructive, because the persistence of fever and cough and the invariable hemoptosis lead to a strong suspicion of tuberculosis or of an encapsulated pleural effusion. On the roentgen plate one may follow the persisting pneumonic infiltration from its early stages for a period of months, noting a gradual increase in its density due to fibrosis. Here cavities are rarely visible, as they are small dilatations of the bronchi which are indistinguishable in the general infiltration. Roentgen pictures such as Fig. 12 afford evidence of an exquisite lobar distribution which at autopsy revealed a

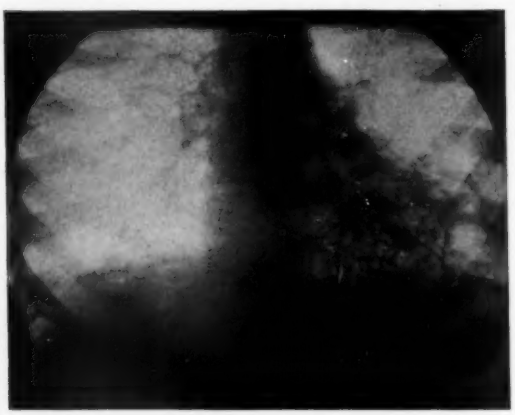

FIG. 13.

general bronchial dilatation. If the bronchi become sufficiently dilated and thin walled the roentgen plate may reveal a honeycombed appearance of the lung (Fig. 13). These cases usually have the most profuse expectoration, the secretion literally pouring out on change of position; they are often secondary to bronchitis or bronchopneumonia contracted in childhood and may be of many years' standing. The element of putrefaction may be quite absent and the integrity of the bronchial wall maintained, so that no large cavity may result. Apparently this condition is compatible with many years of life, as the patients are not menaced by the dangers of a gangrenous process in the lungs. On the other hand, as in the previous group, there may develop single or multiple abscess cavities (Fig. 13a). The cases just described are conveniently grouped as chronic nontuberculous lung infections in contradistinction to cases of tuberculosis which they superficially resemble. Although they are thus frequently diagnosed and are consequently found in sanatoria, it is an easy matter, by means of their characteristic roentgen appearance, to assign them to their proper place.

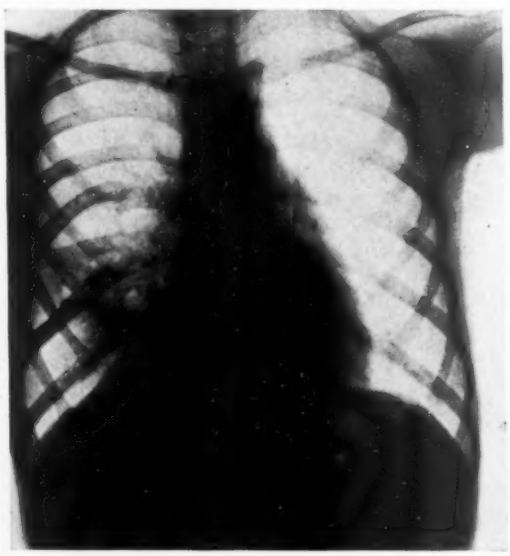

FIG. 13a.

I wish now to present a résumé and analysis of 100 cases of suppurative lung disease and some observations suggested by a study of them.

Etiologically they may be classified as follows:

Postoperative	
a—Posttonsillectomy	21
b—Other operations	5
Postpneumonic	37
Insidious (colds, grippe)	21
Postempyema	3
Aspiration	
a—Immersion	2
b—Coma (drug and alcoholic)	2
Postnasal	1
Tuberculous	2

Postesophagus (carcinoma)	1
Actinomycotic	1
Diabetic	1
Syphilitic	1
Foreign body	2

The cases varied in duration at the time of roentgen examination from a few weeks up to seven years. The postoperative abscesses and those due to aspiration were as a rule encountered during their acute stage in the early weeks. This was also true of 16 of the postpneumonic abscesses. The remainder came under observation on an average of some months after the onset. This fact has an important bearing on prognosis, which will be explained shortly.

The relation of fetid sputum to these suppurative conditions is a matter of some interest. In the postoperative and aspiration cases the gangrene appears to be a primary and essential part of the whole disease. It is a remarkable fact, elicited by careful history taking, that irrespective of the time of onset of pulmonary symptoms evidences of gangrene invariably present themselves on the 13th or 14th day after the operation. This does not necessarily consist in the expectoration of foul sputum; occasionally the patient experiences only a foul odor to the breath or a similar taste in the mouth. This uniform onset of the fetor on the 13th or 14th day is perhaps related to the biology of the anaerobic bacteria responsible for it. The gangrenous inflammation appears also to be intimately associated with the progress of the disease. Usually an aggravation of the symptoms is associated with an increase of the fetor and the sloughing out and expectoration of the necrotic lung may be followed by temporary or permanent improvement. The gangrene also seems to be related to the formation of the larger, easily demonstrable cavities. With respect to the gangrene, the postpneumonic cases appear to fall into two groups. Sixteen of the cases here reported developed an acute abscess following pneumonia. As in the postoperative cases the gangrene invariably began on the 13th–14th day. For this reason it seems to me very likely that the mechanism of lung abscess formation in these cases is similar to that in the operative cases. I think it may reasonably be questioned whether these are not really primary cases of lung abscess, which have resulted from the aspiration of infected material from the mouth, perhaps during sleep. The analogy between these cases and those of lung abscess which develop after coma is so close as to be significant, and it is suggested that at least this one group of so-called postpneumonic abscesses may find its remote origin in diseased tonsils or gums. In the remaining postpneumonic cases the gangrenous process is apparently of minor importance. It is only engrafted after some months on a previous pneumonia which is probably from its inception of a chronic indurative nature. In many of these cases no large cavities are found, and if fetid sputum occurs it does so intermittently, and does not seem to affect the course of the disease unfavorably. Conversely, in all the postpneumonic cases in which a large cavity was visible on the plate, the patients had fetid expectoration.

CAVITIES

The relation between the larger cavities which are demonstrable by roentgen rays to the origin of the disease may be shown as follows:

Aspiration abscess	cavity	21	(37)
	no cavity	3	
Non-aspiration abscess	cavity	29	(13)
	no cavity	30	

If from the 29 cases of non-aspiration abscess which showed a cavity there are deducted the 16 cases of acute pneumonic abscess, which there is reason to believe are also due to aspiration, the corrected figures will appear as in the parentheses above.

It will be seen that the large cavities result more frequently from the acute aspiration abscesses, and this is probably

due to the larger rôle which the gangrene plays in the former. Its importance in causing a rapid breaking down when it is engrafted on a previously diseased lung is well shown in Fig. 14. The history of this patient makes it evident that he was the subject of a chronic pneumonic process of about two years' standing. His expectoration, although profuse, was never gangrenous. After an operation for appendicitis under general anesthesia there is a marked progress of the disease with the formation of a large cavity and putrid expectoration.

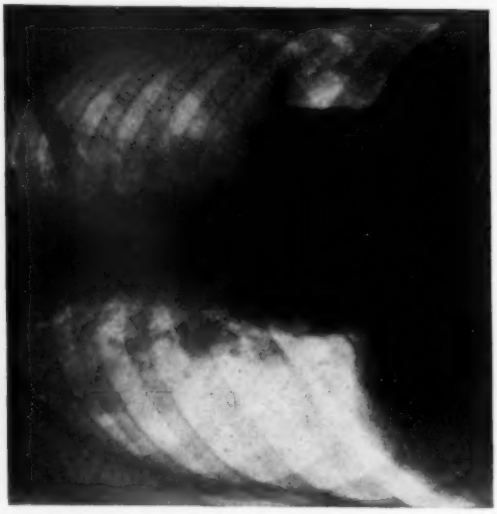

FIG. 14.

PHYSICAL SIGNS OF CAVITY

In only a small percentage of cases were there undoubted physical signs of cavity. In this regard the superior value of the roentgen ray is striking, as it disclosed a cavity in forty-five cases. The value of such a determination and localization in the surgical treatment is, of course, evident if the question of drainage of such an abscess cavity arises. Most cavities are circular in shape and usually do not evidence any definite abscess membrane. They appear rather as a circular or semilunar defect in the infiltrated lung, and in the majority of cases are bisected by a horizontal or slightly concave fluid level. This level is so sharp and is so pathognomonic of a cavity, that its occurrence may be taken as evidence of an abscess cavity even though its superior wall is not seen, as may occur if the infiltration is not very dense. In a doubtful case an exposure in the lateral

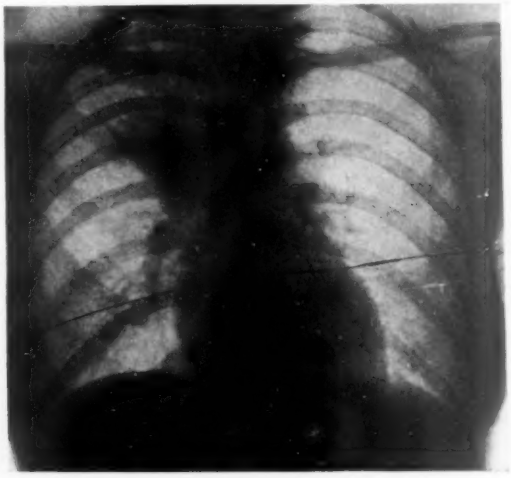

FIG. 16.

recumbent position will demonstrate a shift in the fluid level. Such a manœuver will sometimes disclose a cavity not otherwise visible. Thus in Fig. 14 a lateral recumbent examination exposed the fluid level of a cavity which in the upright posi-

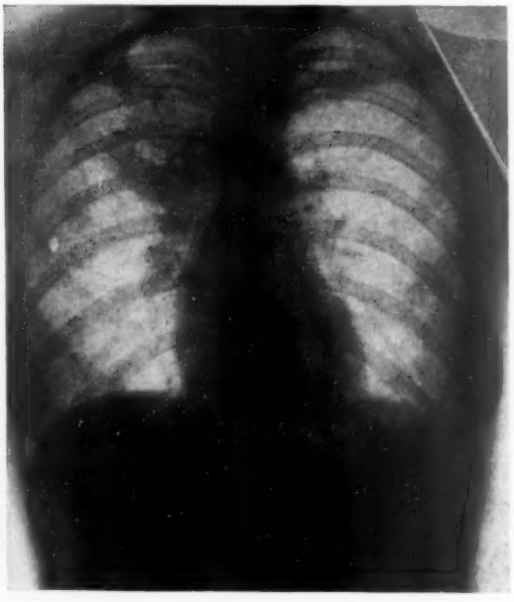

FIG. 17.

tion was obscured by the heart shadow. The multiple diffuse dilatations of the bronchi are visible only in the exceptional case in which the thin walled bronchi are enlarged and spherical and their lumen is not obscured by infiltrated lung (Fig. 13).

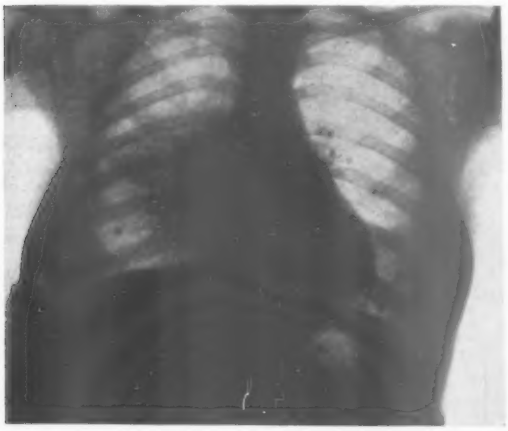

FIG. 18.

The existence of a cavity cannot safely be denied from a single examination, as its demonstration may depend on varying physical conditions. If a cavity is full of secretion, or if it is small and imbedded in the consolidated lung, it may become visible only after it is partly emptied by expectoration, or after a removal of the pneumonic process. Figs. 16 and 17 illustrate such a case. After the expectoration of eight ounces of pus, three small cavities, previously invisible, can now be distinctly seen. In Figs. 18, 19 and 20, there is noted the appearance of a cavity after expectoration, and of several more which came to light after operative removal of some of the overlying indurated lung. Again, in Fig. 21, an oblique view shows an irregular

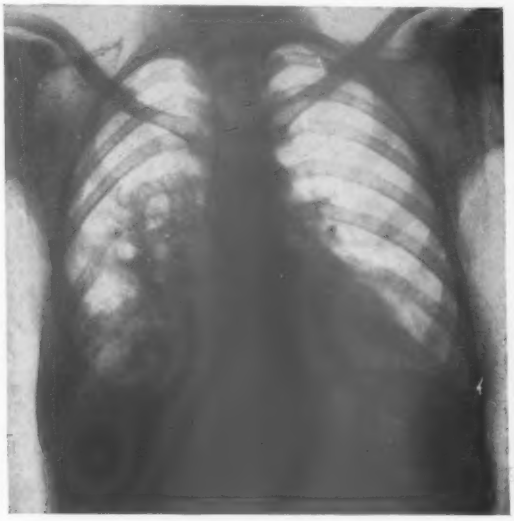

FIG. 20.

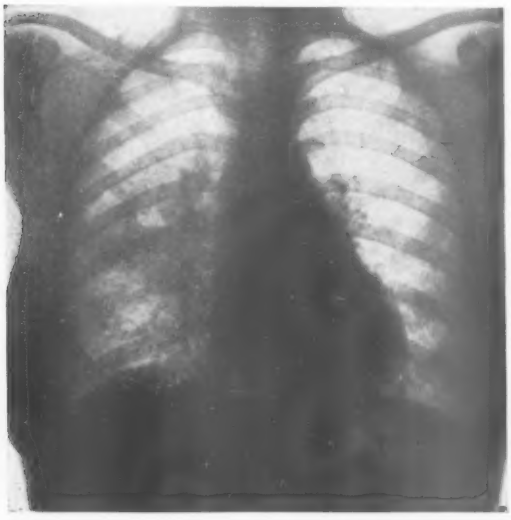

FIG. 19.

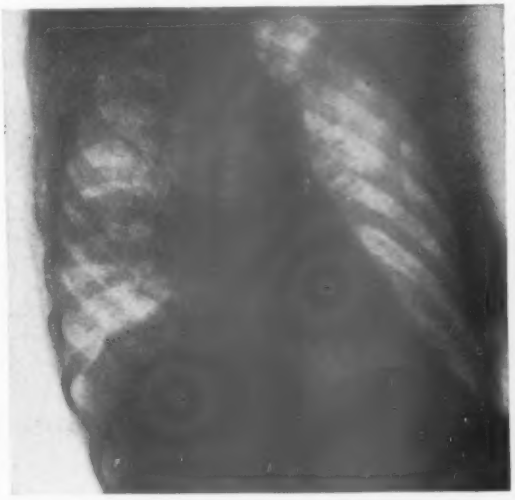

FIG. 21.

cavity in the middle lobe which was not seen in the dorso-ventral position.

LOCATION OF ABSCESS

Suppuration may involve any one or more of the lobes of the lung. Not uncommonly two lobes are affected. This is especially true of upper lobe abscesses, which are frequently a source of infection of the lower lobe.

There is a distinct difference in the localization of abscesses following aspiration and those following pneumonia, as will be seen from the following table:

	Upper lobe	Lower lobe	Middle lobe
Aspiration abscesses.....	18	9	1
Non-aspiration abscesses.	24	44	3

A similar analysis of those cases of acute postpneumonic abscess, which I have reason to believe are also aspirative in origin, shows the following:

	Upper lobe	Lower lobe	Middle lobe
Acute postpneumonic abscesses.....	8	7	1

It will be seen that upper lobe suppuration in aspiration abscesses is twice as common as involvement of the lower lobe. In the remaining cases the conditions are just reversed. Isolated abscess of the middle lobe occurred twice, in one case after tonsillectomy, and once in a syphilitic patient.

One of the more striking symptoms of lung abscess is hemorrhage, as it occurs in almost every case in some stage of the disease. In fact, it is a more constant sign than is hemorrhage in pulmonary tuberculosis. Although it is usually moderate in amount, it is occasionally profuse and in several cases was fatal.

Clubbing of the fingers was present in 12 cases. Its earliest appearance was noted at six weeks after the onset; it usually developed, however, after a few months.

COMPLICATIONS

The complications of lung suppuration present several points of interest. As they occurred in this group of cases they were as follows:

1. Rupture of a bronchiectatic cavity with pyopneumothorax;
2. Empyema;
3. Fatal hemorrhage;
4. Septic embolism of the brain;
5. Arterio-venous aneurysm of the lung;
6. Putrid pneumonia and intoxication.

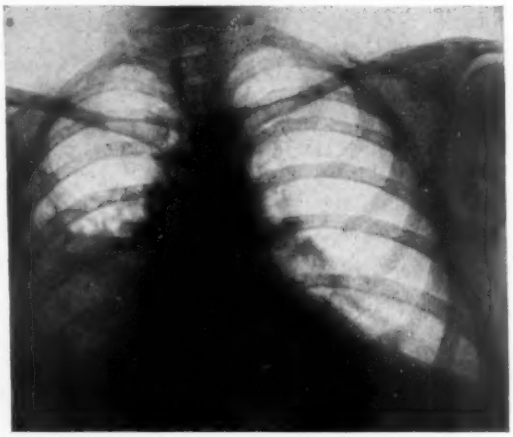

FIG. 22.

Plates 22 and 23 illustrate the sequence of events following rupture of a bronchiectatic cavity. The patient, an elderly woman, had had a cough for nine years and had apparently a widespread bronchiectatic condition of the right lung. A sudden exacerbation of her symptoms

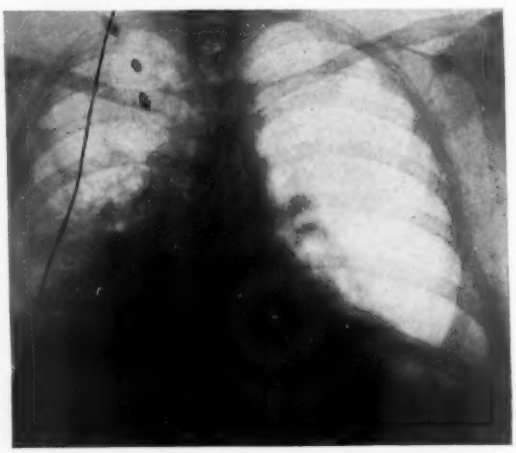

FIG. 23.

is associated with the appearance shown in Fig. 23. The pleural cavity is half full of fluid whose level is horizontal, indicating the co-existence of air and fluid in the chest, which was corroborated on operation. Such a result may be expected when the rupture occurs into the free pleural cavity. Probably more frequently this is preceded by the formation of pleural adhesions, so that on subsequent rupture there develops a localized empyema, which usually communicates with a bronchus. Such a local effusion may thus mask an underlying lung abscess, and only the persistence of a bronchial fistula will lead to the suspicion of a pre-existing lung disease. This is particularly apt to take place in the case of aspiration of foreign bodies, in which, owing to the extreme youth of the patient, a history of such aspiration is not obtainable, and the first evidence of serious disease is the occurrence of an empyema. Foreign bodies are so unexpectedly discovered as a cause for abscess conditions of the lung that no examination can be considered complete until a roentgen examination and bronchoscopy have been performed in order to determine their presence.

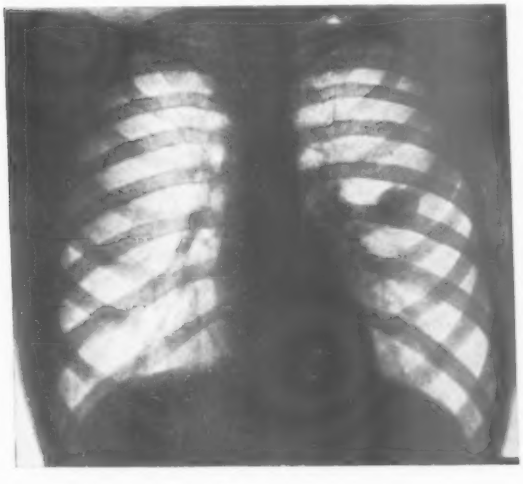

FIG. 24.

Fig. 24 illustrates an unusual sequel of a lung abscess. Eight weeks previous to the examination the patient had a typical postpneumonic abscess with fever, fetid sputum and early clubbing of the fingers. At the time of the examination he was almost well. He was repeatedly examined by the roentgen ray for about a year, and the shadow noted in the plate above remained constantly the same. He then died of cerebral abscess. Autopsy revealed an arterio-venous aneurysm of about the size of a hazel nut surrounded by a thin connective tissue capsule.

FIG. 25.

CURE OF CASES OF LUNG SUPPURATION

In this series of 100 cases, only eleven recovered spontaneously. It may be of some interest to analyze these cases, to determine, if possible, the conditions which favored recovery. Of the eleven cured cases, nine were postoperative abscesses, eight of which followed tonsillectomy. Only two of the cases were postpneumonic. It may even be questioned whether one of these cases completely recovered, as he died of a metastatic brain abscess. It will thus be seen that over one third of the postoperative abscesses recover spontaneously. There appears, however, to be a definite time beyond which such spontaneous healing does not occur. In all the cases healing was complete three months after the onset, and it was probably determined

some weeks earlier. Every one of these cases gave evidence on the roentgen plate of a fair sized cavity. It is evident that no operation should be attempted in these cases until after the lapse of three months. The postpneumonic cases apparently have a bad prognosis, as they lead to a diffuse indurative pneumonia which favors the formation of multiple bronchiectases. Even the acute postpneumonic abscesses, which in other respects appear to resemble the aspiration abscesses, do not appear to get well of themselves. Only two of these cases recovered, although it is possible that several others which passed out of observation also got well. In the postpneumonic abscess of months' and years' standing there is apparently no prospect of recovery by medical measures.

The single case of syphilitic lung abscess recovered completely under specific treatment. This case began to cough rather suddenly and in a short time presented the

FIG. 26.

typical symptoms of lung abscess of the middle lobe (Fig. 25). A vigorous course of salvarsan resulted in a rapid cure and a disappearance of the infiltration (Fig. 26). In a case of abscess of the middle lobe of doubtful causation a course of antiluetic treatment would be advisable.

Of the cured cases, in two, an artificial pneumothorax was attempted. Although the roentgen plate showed that in neither

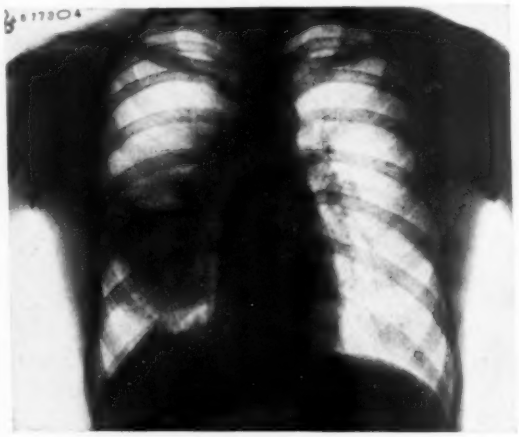

FIG. 27.

was there an effective pneumothorax or a collapse of the lung, prompt improvement ensued on the operation. It is evident that the cure cannot be ascribed to the pneumothorax in these cases, nor does the latter promise to be of any value.

Five cases were cured by operation which consisted in an extirpation of one or more diseased lobes. The operations, performed by Dr. Lilienthal, were undertaken

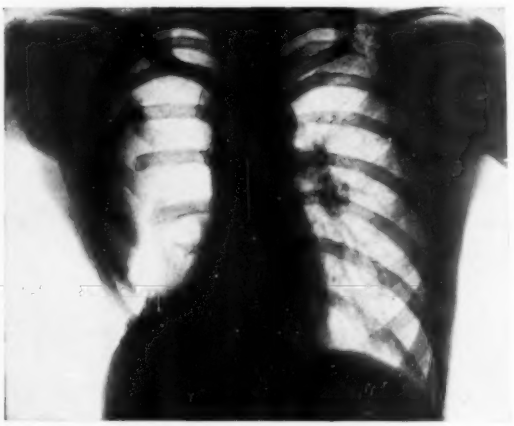

FIG. 28.

only in cases of some months' standing, that is, after the lapse of the period during which spontaneous healing might result.

A cure of these patients by operative means cannot be effected by incision and drainage of one or more abscess cavities. It is necessary to excise all or the greater portion of

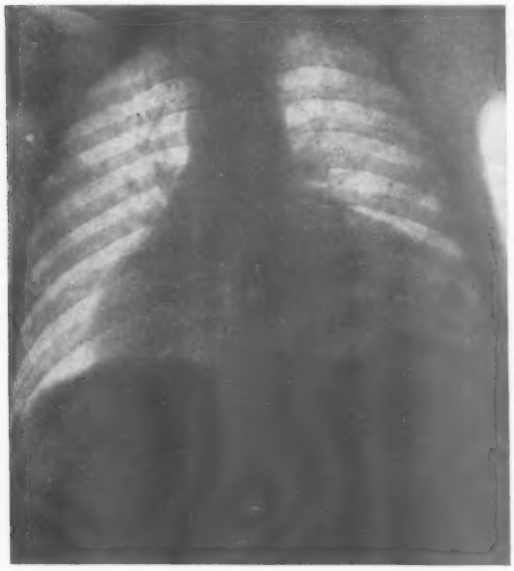

FIG. 29.

the diseased lung. All the interesting details of the operation as developed by Dr. Lilienthal and the postoperative problems cannot be gone into. It is sufficient to say that the roentgen plate reproduces with unexampled faithfulness the results of the various operative procedures and is helpful in gauging their success. Figs. 27 and 28 show an abscess before operation and the appearance of the chest after lobectomy and a plastic operation to collapse it. Fig. 29 represents a foreign body bronchiectatic lung which was completely removed by operation. It is interesting to observe how the remaining portion of the lung expands to fill up the dead space so that a few months later there is no evidence of the previous trouble either in the conformation of the chest or in the appearance of the lung (Fig. 30).

In conclusion, a few additional remarks on the rôle of the roentgen ray in the diagnosis of these conditions may not be amiss. It may be stated at once that in the great majority of the cases, a diagnosis of lung abscess or bronchiectasis can be made from the clinical history alone, without any further examination. The expectoration of purulent or fetid sputum is a symptom so characteristic as to be unequivocal. Little is achieved, however, by the mere diagnosis. In order to arrive at an exact localization, to determine the presence and the location and the size of the cavities or the existence of infiltrations, one must have recourse to physical examination. It is, however, surprising how few physical signs even an extensive infiltration will produce. The most constant signs were dullness, often slight, and diminished breathing over a circumscribed region of the lung. As far as cavities were concerned, in only twelve cases were there indubitable physical signs of a cavity. In the cases with a small residual infiltration, physical signs were usually absent, especially when the disease affected the hilum of the lung. This uncertainty in the results of physical examination is in striking contrast to the clear cut data furnished by the roentgen plate.

FIG. 30.

Further there are cases in which neither the clinical history nor the physical examination furnish grounds for the diagno-

sis of lung abscess,—cases of chronic bronchitis, of tuberculosis or of aneurysm of the aorta, to mention but a few. In such conditions the diagnosis may remain at a standstill until the roentgen ray unearths an area of chronic pneumonia with bronchiectases as a basis for the persisting symptoms.

Although in a majority of the cases the roentgen appearance of suppurative lung disease is characteristic, it will occasionally be difficult to distinguish it from other diseases of the lung, such as tuberculosis, localized empyema, or new growth. In such cases the clinical data, if intelligently utilized, will usually make a diagnosis possible. In no other branch of his work can the roentgenologist bring his clinical and pathological knowledge to bear with greater advantage. But he must be given the same opportunity as the clinician to reëxamine the patient if he is in doubt, in order that he may retrieve an initial error and revise his diagnosis. The value of such reëxaminations is shown in the following case. A much emaciated patient presented the clinical signs of a consolidation of the left upper lobe, and a probable diagnosis of carcinoma of the lung was made (Fig. 31). Subsequent examinations showed this diagnosis to be unfounded. The supposedly solid growth gradually receded from the apex and in its stead there remained a large abscess cavity partly filled with fluid, the rest of which had been evacuated by the patient (Fig. 32).

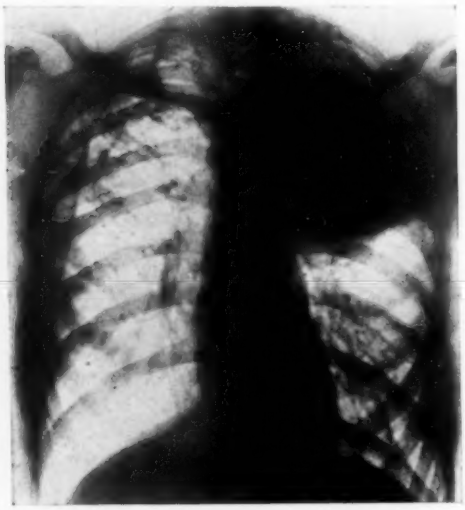

FIG. 31.

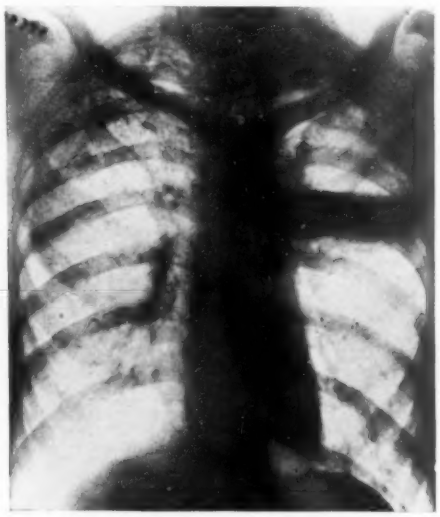

FIG. 32.

THE RADIATOR TYPE OF TUBE

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THE radiator type of tube has already been described.[1] Up to the present time, its use has been confined exclusively to the army and in this service it has been used as a self-rectifying tube in the Portable and Bedside outfits. Owing to the fact that the tube has recently become generally available for use on existing standard generating outfits, the following amplification of what has been published will perhaps be useful.

The leading motive in the development of this type was originally to get, in the form of a small simple and rugged structure, a tube which would operate satisfactorily when alternating current was supplied to its terminals. As will be seen from the following, however, the use of the tube should not be limited to such service,[2] for it will do better diagnostic work on any generating outfit than will the earlier form of hot-cathode tube with the solid tungsten target.

FIELD OF USEFULNESS OF THE RADIATOR TUBE

This type of tube makes possible the use of a simple transformer[3] as a current generating outfit (for direct current circuits a converter must be added). It has been found that a little transformer of suitable design and weighing but slightly over 50 pounds is adequate for supplying a current of 50 milliamperes at a useful gap of 5″ to a self-rectifying tube. This, of course, means that a very small and relatively inexpensive outfit of this type can be made to do even very rapid diagnostic work. The freedom from mechanical and electrical complications and from noise and the diminution in the odors attendant upon high tension discharges in air seem very much in favor of this system.

The tube operates satisfactorily on the transformer, the interrupterless outfit, and the induction coil, and is hence generally applicable to diagnostic work. With the induction coil it renders a valve tube unnecessary. With the interrupterless machine, it offers the advantage that it is not injured by a faulty setting of the mechanical rectifier. With every current source it permits of the intermittent use of more energy than could in practice safely be carried by a tube with a solid tungsten target and the same size of focal spot.

It is not, in its present form, adapted to therapeutic work, for, with continuous operation, it will carry less than one-fourth as much energy as the 7-inch hot-cathode tube with solid tungsten target.

CURRENT-CARRYING CAPACITY OF THE RADIATOR TUBE

For a given voltage, the current-carrying capacity of the radiator type of tube is a very definite quantity. This is due to the fact that the target of the radiator tube cools so rapidly, between exposures, that every exposure is started with a relatively cold target. What can be done with the tube then, in radiographic work, depends but little on its past history.

This will perhaps be made clearer by the following consideration: The target, with its heat-storage capacity, is like a reservoir used for the storage of water. It is capable of absorbing and storing up an amount

[1] *Gen. Elec. Rev.*, 21, pp. 55–60 (1918).

[2] It is, perhaps, necessary to place additional emphasis on this point for the reason that one is instructed in the U. S. Army *X*-ray Manual not to use this tube on large installations or interrupterless machines. This was doubtless, under the circumstances existing at the time, a wise regulation. To apply this regulation to civil practice, however, would be equivalent to saying that no 10 ma. *x*-ray tube should be operated from a large machine.

[3] This word, transformer, is so generally incorrectly used by the roentgenologist that a definition will not be out of place. A transformer is a device for transforming an alternating current of one voltage to that of another. In its simplest form, it consists of two coils of wire placed around a common iron core. It is *not* an "Interrupterless Machine"—the latter consists essentially of a transformer, a synchronous motor, and a mechanical rectifying switch.

of heat energy, which is determined by the size of the target and by the amount of heat already in it, just as the reservoir is capable of taking up an amount of water determined by its size and by the amount of water already in it. The capacity of the target to take up heat is always the same provided it is always at the same temperature at the beginning of the exposure.

It is then a simple matter for the manufacturer to specify the capacity of tubes of the radiator type.[4]

In the particular service for which the radiator tube was first developed, the amount of electrical energy available at the tube terminals was strictly limited and corresponded to 10 ma. at a 5-inch useful gap. The focal spot in the first model was then made as small as could be conservatively used with this amount of energy ($\frac{1}{8}$-inch in diameter). In this connection, the writer wishes to lay emphasis on the word *conservatively*. He has seen one of these tubes which had been in almost constant radiographic service in a base hospital for a period of several months. It had been operated on an interrupterless machine with a load of 10 ma. at a 5-inch gap. Inspection showed that the focal-spot had never even been frosted and could not be identified without operating the tube. Under such circumstances and with such consistent use, there is, of course, a temptation on the part of the operator to increase the load and to exceed the current specified by the manufacturer. The writer, however, cannot see a justification for doing this. If, without serious damage, a current of say 30 milliamperes could occasionally be used with a tube marked 10 ma., it might seem worth while; but it can't be done. It will ruin the tube. With the tube, in the base hospital in question, the current could undoubtedly have been raised 50 per cent and this would have reduced the time of exposure to two-thirds of what it had been. The point which the writer wishes to make, however, is that the gain derived from attempting to operate a radiator tube, or any other roentgen ray tube of any kind, or a jack-knife, or any other device, at the breakdown point is out of all proportion to the cost.

Later in the war it was felt by some that there was need, in the army service, of a limited number of mobile outfits having a higher current capacity than the standard U. S. Army Portable outfit. For this reason, experimental work was undertaken on a larger size, 3 K.W., Delco-light set. It developed that, with certain minor changes, this set, when connected to the small *x*-ray transformer used in the standard Portable outfit, was capable of delivering 30 ma. at a 5-inch useful gap to a self-rectifying tube.

It was found that a radiator type of tube with a $\frac{3}{16}$-inch focal spot behaved nicely with the 30 milliampere load. Except for the larger focal spot, this tube was identical with the 10 milliampere radiator tube.

There is every reason to think that, with a still larger focal spot, this same design of radiator tube will be found equally satisfactory for 100 milliamperes or more, and that it will still operate just as well on alternating as on rectified current.

The current-carrying capacity is the same for alternating as it is for rectified current, as the tube will safely rectify any current which does not damage the focal spot.

OPERATION ON TRANSFORMER (WITHOUT MECHANICAL OR OTHER RECTIFIER)

When used where it has to rectify its own current, the radiator type of tube shows its greatest superiority over the hot cathode tube with the solid tungsten target,[5] used under the same conditions.

[4] In the case of the earlier type of tube with the solid tungsten target, the specification of current-carrying capacity was always rather unsatisfactory for the reason that the cooling of the target in this tube, between exposures, was relatively very slow. Because of this latter fact, the target temperature, at the beginning of an exposure might be anything between room temperature and intense white heat. The amount of heat which the solid tungsten target was capable of storing up and, hence, the current-carrying capacity, was then a very variable quantity, depending on the temperature of the target at the beginning of the exposure.

[5] The latter should never be used to rectify its own current. The reasons will be obvious from the following data.

This is illustrated by the following experimental data:

30 Milliampere Radiator Tube, Operated from Transformer (without Rectifier)

With the target at room temperature, a current of 30 milliamperes at a 5-inch useful gap was applied continuously for 35 seconds. At the end of this time, there was a slight flash of green fluorescence in the tube and evidence of a slight high voltage surge on the line. The target was bright red. No harm had been done to the tube, but it would have been unsafe to continue without interruption.

With intermittent operation, it was found that a 6-second exposure with 30 milliamperes at a 5-inch useful gap could be repeated indefinitely with 40 second intervals between exposures.

With suitable intervals between, exposures with 30 ma. ranging in time from 0 to 35 seconds could then be made.

Medium Focus 7-Inch Tube with Solid Tungsten Target, Operated from Transformer (without Rectifier).

Starting with the target at room temperature, this tube was operated with 30 milliamperes at a 5-inch useful gap for 10 seconds. At the end of this time it showed green fluorescence at the cathode end, indicating that it was beginning to pass inverse current. The target was red hot. Experience has shown that had the operation of this tube been continued further without interruption, it would have been put permanently out of commission, either from cracking the bulb back of the cathode or from deterioration of vacuum.

After waiting 15 minutes for the target to cool, it was found that the tube would carry the 30 ma. load for 5½ seconds, at the end of which time, inverse again appeared. After a further wait of 21 minutes, it was possible to operate it for 7 seconds.

This tube then would have stood, from a cold start, a single 30 ma. exposure of 10 seconds, and repeated exposures of 6 seconds duration with intervals of about 20 minutes between.

Broad-Focus 7-Inch Tube with Solid Tungsten Target, Operated from Transformer (Without Rectifier).

Experiment showed that this tube could be run with 30 milliamperes at a 5-inch gap for 6-second exposures at intervals of 15 minutes.

Further Considerations

With the present design, the 7-inch tubes with solid tungsten target show considerable differences in the evenness of distribution of energy over the focal spot. The two 7-inch tubes tested were taken at random and for this reason they do not represent the worst conditions. Other tubes will be found which will behave even worse than these when operating on alternating current.

It is also a fact that commercial experience with this type of tube operators directly from a transformer (without a rectifying device) has resulted in the rapid destruction of tubes and has been thoroughly unsatisfactory.

The 30 milliampere radiator tube was designed to rectify its own current. It was, in the above mentioned experiments, always much further from the actual breakdown point than were the other tubes. A load much higher than that used would have been necessary to produce inverse with the radiator tube (the fluorescence referred to in the test was due to gas given off from the hot copper and was not a manifestation of inverse current), and, had inverse been produced, it would have been intercepted by the hemispherical cathode and so kept from hitting the glass.

The above tests can then be summarized as follows: Running directly from a transformer (without a mechanical rectifying switch), the 30 milliampere radiator tube was operated for single periods of 35 seconds duration, while the limiting time of operation with the medium focus solid tungsten target tube was 10 seconds.

Six-second periods of operation could be repeated indefinitely with 40-second intervals with the radiator tube, while intervals of 15 and 20 minutes were needed with the other two tubes. Furthermore, the radiator tube was not endangered by the above tests, while the others were being operated very close to the breakdown point.

Attention should be called to the fact that the above tests were forced tests. They are given merely to show the radically different behavior of the two types of tube when operating on alternating current. At the present time, there is certainly no occasion in diagnostic work to use 30 ma. at a 5-inch useful gap for a period of anything like 35 seconds or to make any considerable number of consecutive 6-second exposures with a time interval of only 40 seconds between them.

OPERATION ON INTERRUPTERLESS MACHINE

For satisfactory diagnostic work, it is imperative that a voltage control of the auto-transformer type rather than the resistance type be employed. The use of auto-transformer control will ensure constant voltage and will hence greatly facilitate the duplication of results.

The results obtained should be better than with the tube having a solid tungsten target; for in general, for a given amount of energy, a smaller focal spot can be used in the radiator tube.

The tube also offers this additional advantage, for use on the above outfit, that a faulty setting of the rectifying device, resulting perhaps in sufficient inverse to ruin the tube with the solid tungsten target, will not injure the radiator tube.

OPERATION ON INDUCTION COIL

The radiator tube is well adapted to induction coil use and renders a valve tube unnecessary. The cathode filament may be supplied with current from an insulated storage battery or from a small converter and special step-down transformer. For diagnostic work, however, the induction coil outfit, because of its complications, does not seem competitive with the simple transformer.

USE OF LOW MILLIAMPERAGE

Some enthusiastic users of a 10 ma. tube seem to feel that there is some mysterious advantage derived from the use of low milliamperage per se. In some cases they have gone so far as to take tubes adapted to operation with say 40 ma. and run them at 10 ma.

There is no harm in doing this; but it is easy to show by actual experiment that, provided the same voltage and the same exposure time, reckoned in milliampere seconds, are used, radiographs made with a 40 ma. tube at 10 ma. cannot be distinguished from those made at 40 ma.

It is true that, unless the operator is equipped with a time switch adapted to the measurement of short time intervals, he will time his exposures more accurately when using low milliamperage and longer intervals.

The main advantage, however, to be derived from the use of low milliamperage comes from the fact that it makes possible the use of a tube with a small focal spot. It is easy to demonstrate that, with satisfactory immobilization of the subject, and the same focal-spot-plate distance, the same voltage and the same exposure in milliampere-seconds, the definition is always better the smaller the focal spot.

SHIELD FOR THE RADIATOR TUBE

The main advantage of the split glass shield which has been developed for the radiator tube, consists in the fact that it completely surrounds the tube and is made of thick glass having a high lead content.

In case the focal spot happens to be exactly in the plane of separation of the two halves of this shield, there is seen to be a very thin beam of roentgen rays escaping through the joint. This leakage is so slight,

however, that it would seem to be unimportant. It can, moreover, be completely stopped by seeing that the focal spot is not in the plane of separation. One of the advantages of the present design lies in the fact that it makes possible the condition that each half shield shall fit together with every other half shield to make a pair.

The method of supporting the tube in the shield has come in for deserved criticism. An experimental model has been made in which the outer ends of the glass are threaded to take hard-rubber screw caps. These caps force tapered split bushings of some resilient material, such as cork, in between the arms of the *x*-ray tube and the shield. This holds the tube securely in position in the shield and prevents rotation.

EFFECT OF THE RADIATOR TUBE ON THE DESIGN OF GENERATING APPARATUS

While it is early to make many predictions concerning the new generating apparatus which will be developed for operating this tube, the following statements seem to the writer to be conservative.

Much fluoroscopic work and much radiographic work will be done with a simple transformer outfit operated from a lamp socket. Such small outfits will be very simple and can be made almost fool-proof.

There is a splendid field of usefulness for a small light-weight hand-portable outfit operating on this system, to use in the home of the patient who cannot be moved to a roentgen ray laboratory. Preliminary experiments seem to indicate that a suitable small transformer weighing not more than 40 or 50 pounds can be made for this service.

In the field of dental radiography, it seems certain that the outfits of this type which have already been developed by different manufacturers will find a wide field of usefulness.

CONSTRUCTION OF THE TUBE

The forced large-scale production of the tube, incident to its war use and certain war-time conditions, brought about several radical changes in tube construction.

The fact that an insufficient number of skilled glass-blowers was available made it necessary to develop special machines with which most of the glass-working could be done by girl operators. Help was also obtained by getting from the glass works mold-blown parts, such as the cathode side-arm, and the anode- and cathode-support tubes, instead of making these by hand from glass tubing.

About twelve dollars worth of platinum was needed in every anode and at one time the radiator tube enjoyed the unenviable reputation of being the biggest war-time consumer of platinum that there was. Research work which had been carried on for several years finally resulted in the production of an entirely satisfactory substitute for platinum in this field, consisting of an alloy of iron and nickel covered with copper.

The early exhaust work called for one skilled operator for each tube on the pumps, to control the current supplied to the tube. Experimental work in this field, however, finally resulted in the development of a very simple exhaust system which automatically accomplishes what the best operator had done. The system consists of a small high-tension transformer connected to the tube terminals. In series with the primary of this transformer is a large ballast resistance, the function of which is to lower the amount of energy supplied to the tube as gas is liberated from the glass and the electrodes. The filament-current transformer is operated in parallel with the primary of the high-tension transformer and, as a result of this connection, and the presence of the ballast resistance, the filament temperature is automatically lowered whenever gas is liberated during the exhaust. The entire operation is carried out without adjustment of either the ballast resistance or the filament current control.

SOME ROENTGEN-RAY EVIDENCE RELATED TO THE ETIOLOGY OF CARCINOMA *

BY CHARLES L. MARTIN, E.E., M.D.

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THE cells of the human body may be likened to the inhabitants of a nation. Each one dwells with neighbors of its own class, performs definite duties and obeys certain well defined laws. So long as all of these conditions are fulfilled there are peace and harmony throughout the organization. But when some strange influence creeps in, causing certain cells to become overactive and disobey the laws and limitations to which they have been subject, there is no more peace; the organization begins to totter and a condition exists called revolution in the nation or cancer in the human organism. If it were possible to identify the powerful influence which acts as the instigator of this upheaval, much might be done to eradicate it. Many investigators have attempted this task and as the matter stands today "Chronic Irritation" seems to be the chief offender.

The clinicians have been as active as the laboratory men in searching for evidence, and since clinical findings are often of more value than animal experiments, I wish to consider some of them very briefly.

Everyone is familiar with the contention that malignant degeneration of the skin follows repeated exposure to soot, certain dyes, raw winds, powerful actinic rays, and similar influences. Many observers have held this view for a number of years.

More recently some evidence has been advanced in connection with gastric and mammary malignancy. In 1915 Dr. William MacCarty of the Mayo Clinic made a study of sections from 1373 cases of chronic cystic mastitis. He states that if it is assumed that malignancy exists when a hyperplasia of the epithelial cells has penetrated the basement membrane and invaded the surrounding stroma, 967 of his 1373 cases, that is about 70 per cent were malignant. On the basis of these findings he feels that he may assume that carcinoma is a secondary change following long continued inflammation. However, in the face of this opinion, Dr. Parker Syms of New York published a paper in 1917 in which he makes the following statement:

"If cancer of the breast does occur as the result of a progressive series of processes there have not as yet been made sufficient investigations definitely to demonstrate it as a fact."

In the years 1905 to 1907, Dr. Christopher Graham, also of the Mayo Clinic, advanced the theory that cancer of the stomach might be looked upon as a secondary degeneration occurring at the site of an old gastric ulcer. His reasons were:

(1) That although many cases of gastric malignancy have a short history, about 48 per cent of one of his series of cases gave long histories of gastric disturbance.

(2) That gastric ulcer may have a latent period with no symptoms for years.

(3) That in the year 1906 to 1907 at the St. Mary's Hospital 62 per cent of the malignant tumors of the stomach removed at operations showed a non-malignant or precancerous portion when examined microscopically.

Several workers oppose the theory advanced by Dr. Graham. The conclusions of Dr. George W. Holmes of Boston are of interest. Dr. Holmes bases his opinion on the findings in the cases examined by means of the barium meal and the roentgen rays at the Massachusetts General Hospital during the past five years. He has during that time made a diagnosis of gastric or

* Read before the Boylston Medical Society of the Harvard Medical School.

duodenal pathology in 1273 cases. To those who doubt the accuracy of roentgen-ray diagnosis in gastric conditions, I wish to quote the following figures: In the year 1914–15, Dr. Holmes made a correct diagnosis of 87.8 per cent of the duodenal ulcers, 96.7 per cent of the gastric carcinomata, and all of the gastric ulcers that came to operation. He feels that cancer of the stomach is not as a rule a secondary change occurring on top of an old gastric ulcer because:

(1) Ulcer is about twice as common in the duodenum as in the stomach while no primary malignancy in the duodenum has ever come under his observation. In his series of 1273 cases, the diagnosis of duodenal ulcer was made 594 times and that of gastric ulcer 364 times.

(2) If Dr. Graham's theory were true one would expect to find many more cases of gastric ulcer than of gastric malignancy. In Dr. Holmes' series the diagnosis of gastric carcinoma was made 315 times and that of gastric ulcer 364 times.

(3) Most cases of ulcer have a long history covering several years while the history of cancer is usually a matter of months.

(4) The ulcer case usually has suffered from pain for a long period. The cancer case suffers from pain for a relatively short period, if at all.

In summing up this very brief survey of the clinical evidence I think it is fair to say that chronic irritation has not been proven definitely to be the sole etiological factor in the production of cancer.

Let us now turn to the experimental side of the problem. The history of experimentally produced carcinoma is a very brief one since it may be said to have begun with the work of Bernard Fischer published in 1906. He used a fat soluble dye, scarlet red, as his stimulating agent and produced marked epithelial overgrowth and invasion of subepithelial tissues with epithelial cells thereby. Although these structures looked somewhat like malignant tumors histologically they probably were not, since they ceased to grow as soon as the effect of the dye was exhausted and did not produce metastases.

In 1910 three French experimenters, Marie, Clunet and Lapointe, published an account of their experiments on white rats with the roentgen ray. They stated that, following repeated exposures, their animals developed a dermatitis and that finally two rats developed growths which appeared to be spindle cell sarcomata. These growths recurred after removal by operation and were said to grow into the muscle and peritoneum, destroying these structures.

In 1914 Fibiger stated that he had produced malignant tumors in the stomachs of rats by allowing them to eat roaches which were infected with the parasite spiroptera. This parasite has a very stimulating effect on the lining epithelium of the stomach and six stomach tumors appeared in the animals to which it had been fed. Four of these tumors were said to metastasize. The editor of the *American Medical Journal* in discussing this work suggests that the malignant growths following infection of the human bladder with Bilharzia may have a similar etiology.

In the year 1915–16 two Japanese scientists, Yamigawa and Ichikawa, working at the University of Tokio, brought forward some very strong proof favoring the chronic irritation theory. Their experiments were performed upon the ears of rabbits upon which structures spontaneous carcinoma has never been observed. The inner surfaces of the ears were painted with coal tar every two or three days for periods of from 50 to 400 days. They obtained epithelial overgrowth and what appeared to be true squamous cell cancers in this way. The epithelium of the hair follicles seemed to react most vigorously and the follicles often formed retention cysts. After 30 to 60 days of repeated stimulation the hair follicle epithelium developed into minute nodules which later took on a polypoid or verrucose form. The wartlike structures in some cases formed

cutaneous horns after the stimulating applications were stopped. The ear cartilage, veins and lymphatics were found to be invaded by the tumor cells in several of the animals and two showed metastases in the lymph nodes at the bases of the ears. The tumors on the ears of these two animals grew steadily after the applications of tar were stopped and the rabbits lost weight. One of them weighed about one half its original weight at the time of death. The tumors produced by these workers, which they call folliculo-epitheliomata, seem to be the nearest approach to real experimental neoplasms that we have at present.

Last July a paper was published by Doctors Bullock and Rohdenburg of Columbia University in which they give their results following the application of mechanical and chemical stimulation to the lining epithelium of the stomachs of rats. They used celluloid balls covered with pigs' bristles, pieces of cork armed with pin points and sponges and pieces of wick soaked in scharlach R oil and pine tar oil. They obtained papillary and polypoid tumors in the squamous cell portion of the stomach which resembled cystadenomata. However, the conclusion of their article reads as follows:

"In irritation tumors a typical proliferation and invasive growth, even when extensive, are doubtful criteria upon which to base a judgment of malignancy; in the absence of continued growth after the action of the extrinsic irritant has ceased, experimental tumors should not be classed as malignant however close be the morphological resemblance.

"The fact that the lesions reported by the various observers quoted are produced as readily in young as in old animals and that apparently they do not possess the power of continuous growth upon transplantation into animals of the same species, increases the doubt regarding their malignant properties.

"All of these facts point to the conclusion already deduced from clinical observation that age, organ specificity, and congenital defects play an important, and in many cases a decisive, rôle in the determination of the origin of cancer and that irritation alone is an insufficient factor."

In all of this work it would seem that one of the most likely ways of producing malignancy has been very much neglected. I refer to the use of the roentgen rays. In 1909 Dr. C. A. Porter collected the records of 47 cases of severe roentgen-ray lesions, 36 of which he says were undoubted epidermoid cancer, while four were described as beginning epithelioma and two as questionable sarcomata. In considering this series of cases, there are three points of interest which stand out prominently:

(1) The greater number of malignant tumors appeared in persons ranging from 30 to 40 years of age. This is near the lower limit of the cancer age and would indicate that the rays may exert a powerful influence towards malignancy.

(2) The periods of exposure (not continuous of course) preceding the appearance of the cancer varied from three to eleven years. These periods exceed any that have been used experimentally and seem to indicate that chronic irritation, or perhaps it would be better to say chronic radiation, may produce malignancy if continued long enough regardless of the age of the subject.

(3) Malignancy has occurred only where the direct rays have had access to the skin. Even thin clothing has served as a protection. It is very possible, therefore, that only the very softest and least penetrating rays are responsible for the changes noted.

Chronic roentgen ray dermatitis, that is, the type which was contracted by so many of the early workers who used no protection, shows certain definite features. The skin is dry and thick, the hair falls out, small telangiectases appear, the nails are ribbed, and keratoses are commonly found. Later the keratoses are more numerous, paronychia appear, chronic ulcerations heal and break down repeatedly and finally an epithelioma begins at the

site of an inflamed keratosis or in a chronic ulcer. Since the sequence of events in such cases seemed so logically arranged and since the etiological factor was so definite, Dr. S. B. Wolbach, who made a careful study of many sections of material removed by Dr. Porter at operation, felt that experimental cancer could be produced by repeatedly exposing the skin of animals to the roentgen rays.

This work was undertaken on a small scale, but the difficulties to be overcome were many and up to the present no malignancy has been produced. However, some of the findings are of sufficient interest to warrant a brief description. White guinea pigs were selected because fair skinned people seem to be most susceptible to cutaneous epithelioma. The bellies of these animals were shaved and an animal board was so equipped that when fastened upon it the entire pig, with the exception of an area 2½ cm. square on the shaved belly, was screened from the rays. A Coolidge tube energized by a Biddle roentgen-ray coil was centered over the square area in the screen at a fixed distance above it. Since there are no accurate instruments for measuring roentgen rays it was decided to use as a unit of exposure that dose just sufficient to produce an erythema of the skin. It was rather interesting to note that when this dose was given, the longitudinal dimension of the square area exposed began to decrease until at the end of 12 days it measured less than 1.0 cm., while the transverse dimension remained practically constant. On about the eighth day the skin became brown and by the tenth day a scaly desquamation appeared and the hair began to fall out.

In order to acquire a definite knowledge of just what changes occurred in the skin following the unit exposure, six animals were exposed in exactly the same manner and one was autopsied every second day thereafter and sections made of the exposed skin. Some of the more outstanding features in these preparations are given below:

(1) The *horny layer* begins to thicken at the end of four days and at the end of six days is considerably thickened, takes a deep stain, and shows some disintegration. At the end of 12 days much of the layer is desquamated and the remaining portions are dense and stain deeply.

(2) The *epithelium* shows rather marked changes. At the end of six days the cells are much enlarged and the nuclei are four or five times their original size. The sulci are much less noticeable than in the normal skin where they are very prominent. There is an occasional mitotic figure seen. At the end of 10 days the picture is much the same except that the epithelial layer has become much thicker. At the end of 12 days there are five or six layers of cells in the epithelium whereas there are only two or three such layers in the normal skin. Mitotic figures are easily found. The epithelial layer is much thicker than normal and the sulci are practically all smoothed out.

(3) The *hair follicles* are farther apart than in the normal skin at the end of eight days. After 12 days very few of them contain hair shafts and the central portions seem to be filled either with epithelial cells or with fibrous tissue.

(4) The *corium* shows changes which are perhaps the most interesting of all. At the end of two days the collagen bundles have increased to four or five times their former thickness and take a deep homogeneous stain. The spaces between the bundles are very much narrower and the connective tissue cells show no changes. At the end of 12 days the picture is practically the same except that the changes are more pronounced.

(5) The *blood vessels* show little reaction to the unit dose of roentgen rays. In some of the sections they seem to be dilated and are filled with blood cells, but in others this is not the case.

Having determined upon a unit, the next step was to study the effect of the repeated application of this unit dose to the same area. Many difficulties arose

in the course of this procedure. It was discovered after losing a score of the animals that when the unit dose was repeated within an interval of two weeks, the pig always died. It was also observed that the effect of the same dose became considerably greater with each repetition; that is, the skin seemed to become more susceptible each time it was radiated. Intercurrent disease carried off many of the pigs after they had been radiated for several months.

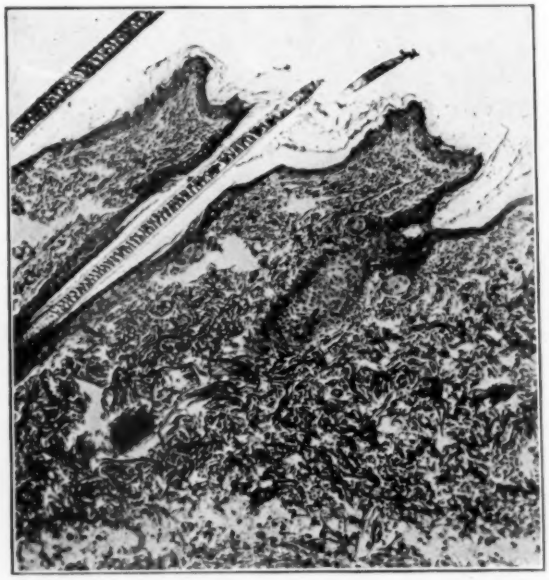

FIG. 1. SECTION OF NORMAL GUINEA PIG SKIN OUTSIDE THE RADIATED AREA SHOWN IN FIG. 2. THE HORNY LAYER IS INTACT, THE EPITHELIAL LAYER THIN AND THE COLLAGEN BUNDLES THIN AND RATHER WIDELY SEPARATED.

One of the animals lived for three months and ten days and during that time received four unit doses over the same area. Some 12 days after administering the first dose this area contracted, lost its hair, became brown, and began to scale. After the third dose it took on a purplish color and a black crust slowly formed. After the fourth dose this crust began to separate at the edges leaving a raw ulcerated surface below. It is rather strange that at no time did this surface become infected. The last two exposures were too close together and the animal died with the signs shown by all of those which received too frequent radiation; that is, it became emaciated, too weak to stand, and developed a diarrhœa. The actual cause of death may have been some infection but the primary cause was undoubtedly a toxic roentgen-ray effect. Sections including the ulceration and the normal skin on either side of it were made and stained with phosphotungstic acid hematin.

The slough is composed entirely of fibrous tissue, the epithelium over this

FIG. 2. SECTION OF SKIN FROM ABDOMEN OF GUINEA PIG 12 DAYS AFTER RECEIVING THE UNIT DOSE OF ROENTGEN RAYS. THE HORNY LAYER IS THICKENED AND DESQUAMATING, THE EPITHELIAL LAYER IS THICKENED, AND THE COLLAGEN BUNDLES ARE THICKENED AND IN CLOSE APPOSITION. MAGNIFICATION SAME AS IN FIG. 2.

area having long since disappeared. The outer layer takes a deep blue stain and apparently is dead and degenerating. Beneath this there is a stratum taking a pink stain and consisting of very much swollen collagen bundles closely packed together, giving the layer a hyaline appearance. Deeper still there is a layer of connective tissue which approaches the normal in structure. This slough seems to indicate that the effect of the roentgen rays diminishes rapidly as they penetrate deeper into the tissues. It is probable that the very soft roentgen rays are the ones which cause the changes in the colla-

gen fibrils and that they are absorbed before they reach the deepest layers of the corium.

At the edges of the lesion there exists an

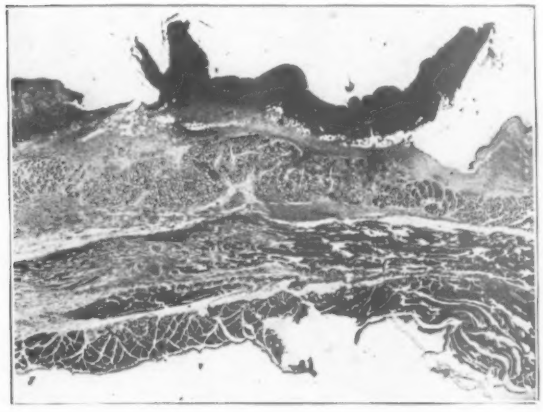

FIG. 3. VERY LOW POWER VIEW OF THE ULCER OBTAINED ON THE ABDOMEN OF THE PIG RECEIVING 4 UNIT DOSES. THE DARK STAINING SLOUGH IS DEAD FIBROUS TISSUE.

exaggeration of the condition observed in the 12-day slides. The horny layer is thinned out until there is little left of it, the epithelium is much thickened, the sulci are smoothed out, the hair follicles have for the most part disappeared, and the corium is thickened and shows the changes in the collagen bundles noted in the previous sections. In addition to these findings there are in two sections structures which have the exact morphology of epithelial pearls. Both of them are situated at the edge of the ulceration near the point at which the thickened epithelium leaves off. One is located in the corium and one in the epithelial layer itself. One can only conjecture as to the significance of these pearls, if they are such.

These few experiments show definitely that the collagen bundles and perhaps the epithelium also react markedly when exposed to the roentgen rays. Some explanation of this reaction should be advanced, but it is very difficult to explain why the roentgen rays which are supposed to be very rapid vibrations in that intangible medium known as ether should produce such changes.

The ionization theory would at once be brought forward by some. Ionization means merely the changing of a substance so that its conductivity for electricity is increased. Air and some liquids normally conduct little or no electricity, but while the roentgen rays are passing through them they are capable of conducting a quantity sufficient to be measured by a delicate instrument. That the normal activity of cells involves electrical phenomena is hardly to be doubted in the face of the electrocardiograph, the instruments for measuring the currents preceding striated muscle contraction, etc. Lazarus Barlow, an English scientist, states—that there is a definite amount of radioactive substance in the normal human body which he has been able to measure accurately. He also states that there is about 20 times as much of this substance in the body when malignancy is present. It may be possible, therefore, that interference with the normal electrical mechanism of the cell is responsible for its changes.

FIG. 4. HIGH POWER VIEW OF A SMALL PORTION OF SLOUGH SHOWN IN FIG. 3. THE DARK STAINING LAYER IS COMPOSED OF NECROTIC FIBROUS TISSUE. BELOW THIS LIES A ZONE OF DENSELY PACKED COLLAGEN FIBRILS. AT A STILL LOWER LEVEL THE FIBROUS TISSUE APPROACHES THE NORMAL.

However, ionization can hardly be said to be the only factor involved, for ionizing power has been shown to be proportional to the quantity of roentgen rays used regardless of their character. Since hard and soft roentgen rays in the same quantities are thought by many to produce different effects on tissues, other forces should be considered.

The chemical reactions following roentgen radiation have not been worked out sufficiently to help materially in explaining tissue changes. It has been shown that certain platinocyanides change color, that iodoform liberates chlorine, that inorganic colloids in suspension may be precipitated, that albumen becomes less viscous, and that starch shows a decrease in viscosity and opacity during radiation. Dr. Bovie, of the Cancer Research Commission, states that there is a marked increase in photo-instability of many of the proteins and amino acids as we pass from the sunlight region of the ultra-violet to the regions of higher vibration frequencies. It is in this region of higher vibration frequencies that the roentgen rays lie. It seems quite likely that some interesting facts will be revealed when the roentgen rays are applied more extensively in the study of bio-chemistry.

The biologist is perhaps the proper authority to turn to for information concerning the individual cell. The German investigator, Schaudin, in 1899 exposed certain forms of sporozoa, flagellata, and infusoria to the roentgen rays. Broadly speaking, he found the sensitivity to increase as the protoplasm became more fluid and the nuclei more numerous. Many of the organisms drew in their pseudopodia, became globular, and burst much as if they had absorbed liquid until they could hold no more. Since the exact structure of the collagen fibrils is not known, it is difficult to say whether the swelling of the bundles may be likened to the swelling of the one-celled organism. The increase in size of the epithelial cells is probably the same sort of a reaction. The influence of the roentgen rays on the developing cells in embryological life has been demonstrated by a number of workers. Ova may be killed outright or stimulated to such a degree that they produce all sorts of monstrous embryological structures. Since the cancer cell is supposed to take on the characteristics of the embryological proliferative cell, it seems quite probable that the rays should have the power of inducing malignancy.

Although this influence may be negligible in isolated skin exposures, the general effects of the roentgen rays should receive some consideration. A heavy dose administered to the whole body of an animal causes decided changes in the blood. A primary rise in the white count is followed by a marked fall. I was able to cause the white count of one of my animals to drop from 15,000 to 500 in four days by administering one dose of roentgen rays. This animal died with all the signs shown by the animals receiving too frequent exposures in the skin experiments. The red cells show a slight decrease but this change in no way compares with the one exhibited by the nucleated forms. Why the roentgen rays should pick out the nucleated cells in the bloodstream and the non-nucleated collagen material in the corium of the skin is not easy to explain.

One could hardly leave the field of conjecture without touching upon the glands of internal secretion. They seem to be the regulators that govern the functioning of many parts of the body. When the thyroid gland begins to exert undue influences upon the processes under its command, the roentgen rays have the power of returning the organ to something like its normal state of activity. When the ovaries become overactive and metrorrhagia results, the roentgen rays are capable of restoring their normal periodic functioning or of destroying it entirely. The testicle may be temporarily or completely incapacitated by irradiation. In some cases the enlarged spleen reduces in size rapidly after a few roentgen-ray exposures. None of these

phenomena may enter into the production of malignant growths and yet they should be considered.

This rather hasty and incomplete survey of the reactions dependent on radiant energy will, I believe, impress the reader with the futility of attempting to explain tissue changes on the basis of the data now available. Future experimentation will undoubtedly show relationships between some of the changes described.

SUMMARY

In summarizing the original work described in this paper, a few points may be worthy of emphasis:

(1) The skin covering the abdomen of a guinea pig shows marked contraction after receiving an erythema dose of roentgen rays. A similar condition has been observed by surgeons in the very dense fibrous tissue surrounding a tumor treated by roentgen radiation. It has also been observed that the vagina sometimes contracts so that it will not admit the examining finger after cervical malignancy has been treated with radium.

(2) Since the connective tissue changes are the first to occur following the exposure of guinea pig skin to the roentgen rays, it may be that the changes in the epithelium occurring some eight days later are secondary reactions due perhaps to an interference with nutrition.

(3) If a single exposure causes a stimulation of the epithelium as a result of changes in the corium, repeated exposures may so change the subepithelial structures that the epithelium is chronically stimulated and thereby finally urged on to active proliferation.

Dr. Wolbach in his article entitled "The Histology of Chronic Roentgen-Ray Dermatitis," published in 1909, described very pronounced connective tissue changes similar to those obtained in these experiments. His preparations also showed vascular obliteration and he suggested at that time that the primary cause of the malignancy following roentgen-ray dermatitis might very possibly be in the corium. He also called attention to the fact that Ribbert, Goebel and Wyss have advanced similar theories. It would be interesting to know whether the tumors produced on the ears of rabbits by the repeated application of coal tar showed any fibrous tissue changes in the early stages. It may be that these tumors which begin in the hair follicles are entirely different from those following roentgen-ray dermatitis.

Unfortunately, this paper has consisted for the most part of conjecture. The field of roentgen-ray experimentation is, as must be realized, very little exploited. That radiant energy is vitally related to the physiology of living matter seems evident. It has the power to stimulate tissues or to destroy them; it produces pathological structures and yet these same structures may be eradicated by it; it may produce a generalized disease followed by death and yet its judicious use often returns the diseased organism to a state of normal functioning. In a word, we have in our hands a most powerful agent for good and for evil. More careful study and experimentation are needed in order that we may derive from it only the good results.

LOCALIZATION OF FOREIGN BODIES AT THE FRONT

THE NEAREST POINT METHOD. THE PALPATING STICK *

BY CHARLES A. WATERS, M.D.

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BALTIMORE, MD.

SINCE the beginning of the war medical periodicals have been over-abundant in articles dealing with the localization of foreign bodies. Case exhaustively reviews the literature of the Allies in 1918 on this subject and digests about two hundred odd articles showing the great similarity which exists in all of their methods. It is interesting to see how many of them employ, as their working basis, the well-known geometric principle of similar triangle construction.

My object in presenting this paper is not to add anything new in localization, but for the purpose of visualizing, to those not fortunate enough to get to France, of what localization of foreign bodies at the front really consists; of showing you the importance of employing a rapid, simple and fairly accurate method for this purpose, and briefly describing that method which we used.

This method has been used in scattered parts of France with slight variations in technic. The first description that I found of this method is that by Gordon Richards published in the *Journal of the Royal Army Medical Corps*, 1917, page 221, in which he describes it as a simple method of locating foreign bodies. No doubt it has been recorded many times but it was through the courtesy of our French colleagues that we first saw it used and this method, which ranks foremost as the one used in our army, surely should have a little more recognition than it has heretofore received.

I might state that the first roentgenologists who went to France after our entry into the war, were confronted with a different method of localization at each place they either visited or were stationed. These methods, generally speaking, had a tendency to become simpler as one approached the hospitals nearer the front. In fact, some of the base hospitals in Paris employed such tedious and complicated methods that I, personally, would have been months learning how to employ them.

I should like to state that mathematically accurate localization of foreign bodies is not necessary at the front. Why? Because the ability on the part of the surgeon to remove these projectiles does not depend so much upon the roentgenologist's skill in telling the surgeon how many centimeters the foreign body lies under a certain mark on the skin, but upon the surgeon's ability to do a thorough and complete débridement.

It is not my desire nor my duty to go into detail about how a débridement should be done, but suffice it to say that when done properly and the track of the projectile dissected out *in situ* the projectile will always be found at the end of this track.

On the other hand if the surgeon for some reason fails to follow or loses the track produced by the projectile, he will always experience more or less difficulty in finding the foreign body because the relationship of the muscles and marks on the skin have been altered or destroyed by the operation.

I mention these points because they are the real factors which exist in an evacuation hospital or any hospital situated near the front, and, combined with the huge numbers of patients that one is required to examine when working in an active sector, it is again evident why the most simple and speedy method be employed in this work.

My first real experience with roentgen ray work at the front came in September,

*Read in part before the Mid-winter Meeting of Eastern Roentgenologists, Atlantic City, N. J., Jan., 1919.

1917, when I was ordered, as roentgenologist on a surgical team, to the largest and best equipped hospital in the French army (Fig. 1).

This hospital, which was composed of wooden barracks accommodating four thousand bed patients, was situated on the Chemin des Dames front, eight kilometers behind the front line. From the grounds of this hospital we could see shells bursting in the trenches.

Those in charge of the work at this hospital were of the best in the French army. The roentgenologists were young, capable men who had been through this work for over three years and who knew all the tricks in localization.

The lessons which we learned at this place were very important, and subsequently had some bearing on the policy which was finally adopted in our army.

FIG. 1. BIRD'S-EYE VIEW OF THE FRENCH EVACUATION HOSPITAL AT VASSENY, FRANCE, NEAR THE CHEMIN DES DAMES, WHERE WE LEARNED TO USE THE NEAREST-POINT METHOD. THIS 4000-BED HOSPITAL WAS 8 KILOMETERS BEHIND THE TRENCHES AND WAS SUBSEQUENTLY BURNED IN THE FRENCH RETREAT ON THIS FRONT IN JUNE, 1918.

Among these lessons, we learned the importance of team work and organization of staffs into shifts, each shift usually working eight hours. The necessity of having a much larger number of trained men available was also impressed upon us.

Furthermore, it was at this hospital that we first became acquainted with the nearest point method of foreign body localization.

THE NEAREST POINT METHOD OF LOCALIZATION

The nearest point method of localization is the palpation, under fluoroscopic observation, of the soft tissues in the region of the projectile. The palpation of the soft tissues is done with a wooden stick about ten inches long with a metal screw or tack inserted into each end. This is known as the palpating or "joy" stick.

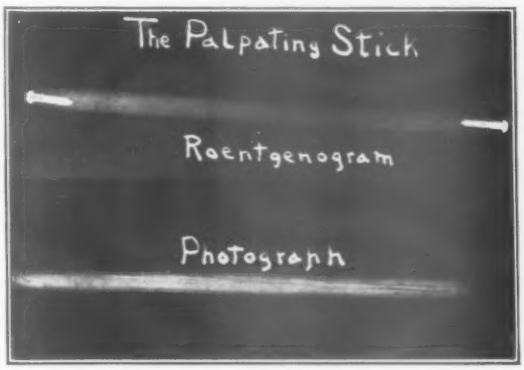

FIG. 2. ROENTGEN RAY AND PHOTOGRAPH OF THE PALPATING STICK.

Under the screen the nearly transparent wood can be only faintly seen while the sharp contrasted shadow caused by the metal screws is plainly visible (Fig. 2).

The purpose of palpating the soft tissues with this instrument is to determine whether the foreign body can be moved, and how much.

FIG. 3. LIEUT. IRA LOCKWOOD EMPLOYING THE NEAREST-POINT METHOD OF LOCALIZATION. NOTE THE MANNER IN WHICH THE STICK IS HELD.

By exerting light and deep pressure on the soft tissues with the stick it is possible to determine with fair accuracy the depth at which the projectile lies under the point on the skin surface where the pressure is made (Fig. 3).

Skill in this method increases with continued use and a sense of pressure is developed which proves a valuable aid in quickly estimating the depth of the projectile.

By holding one end of the stick against the skin surface and shifting the tube from side to side, the simple parallax method can be combined, which often helps a great deal in cases where the projectile is embedded in the bone or has entered the joint.

Generally speaking a projectile, in the soft tissues, which yields movement by light pressure exerted on the palpating stick, would lie about two to three centimeters under the skin.

If deep palpation is necessary in order to produce movement of the projectile, it is, I believe, safe to say the projectile lies about four to five centimeters under the skin.

The nearest point method is most applicable to localization of projectiles in the soft tissues of the extremities, the axilla and triangles of the neck, particularly, and also the scrotum and buttocks.

In cases where foreign bodies are located in the cranium, chest and abdominal cavities, the nearest point method has its least use. However, as I mentioned above, in combination with the parallax method used in bones and joints, it will still give the most accurate and quickest evidence in the localization of the projectile.

I realize this has been an exposé of an unscientific method used in the localization of foreign bodies; but it is for that reason that I wished to bring to your attention its great importance and practical use regardless of its unscientific principles.

REPORT OF CASE SHOWING AIR WITHIN THE CRANIAL CAVITY

BY R. J. MAY, M.D.

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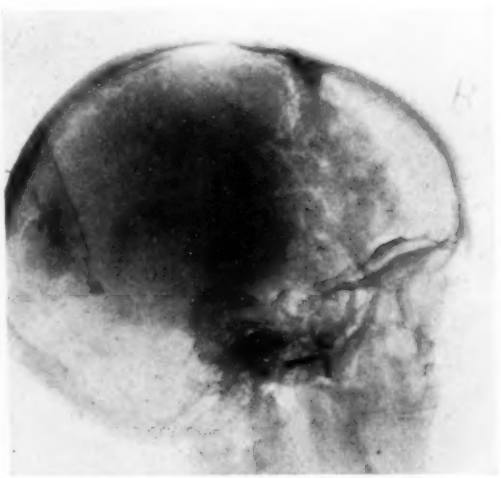
CLEVELAND, OHIO

MISS L. H., aged 55, while crossing the street late at night, was knocked down by an automobile. She was unconscious when picked up and was still unconscious when brought to St. Luke's Hospital where she died several hours later. No operative interference was attempted. She sustained a scalp wound in the occipital region and numerous contusions of the face and body. There was some bleeding from the nose and mouth.

The roentgenograms was made the next morning, several hours after death.

The plates show numerous fracture lines involving both the vault and the base. A fracture of the right frontal bone extends into the right frontal sinus. A large crack in the base beginning in the floor of the sella turcica passes downward through the sphenoid sinus into the naso-pharynx. A large air space is shown in the frontal region.



ESOPHAGO-TRACHEAL FISTULA

REPORT OF CASE PROBABLY DUE TO SYPHILIS, COMPLICATED WITH A PULSION DIVERTICULUM *

BY ISAAC GERBER, M.D.

PROVIDENCE, R. I.

THE following case is presented partly because of the rarity of the condition itself, as only one or possibly two cases of esophago-tracheal fistula due to syphilis as recognized by roentgen ray examination have been reported; and also because it is the first case, so far as the writer is aware, in which such a fistula has been found to be associated with the presence of a pulsion diverticulum.

The patient was a man of sixty-five, a bronze worker by occupation, admitted to the Rhode Island Hospital on Nov. 18, 1918. He entered on the service of Dr. H. P. Abbott, through whose courtesy the writer has the privilege of reporting this case. The previous history was negative, with the exception of a story of dizzy spells off and on for the past two years.

Five months before entrance, while eating an apple, a piece stuck in his throat, after which he experienced a slight difficulty in swallowing. As it did not trouble him very much, the patient did nothing further about it. Two months later, he again noticed some difficulty in swallowing, and then began to vomit occasionally. This condition gradually grew worse. The dysphagia, which at first was limited to solids, was gradually extended to liquids. For eight or ten days previous to entering the hospital, the patient stated that he had not been able to keep anything but a small amount of liquid on his stomach. Immediately after swallowing, he would begin to cough, and finally vomit the food taken. No pain or soreness was felt in the throat.

Physical examination showed a well-developed but markedly emaciated man, who was coughing considerably. The examination of the heart showed that the sounds at the apex were regular but of poor quality. The aortic second sound was accentuated, and greater than the pulmonic second. A short, harsh, systolic murmur was heard in the aortic area, and transmitted slightly into the neck, but not to the præcordia. The area of dullness over the base of the heart appeared to be slightly widened. The examination of the lungs and abdomen was negative. The reflexes were normal.

Roentgen Ray Examination.—A small amount of a rather thick mixture of barium and buttermilk was given. Shortly after swallowing the mixture, a violent fit of coughing began. The patient was able, however, to hold his breath long enough for a stereoscopic set of plates to be taken in the postero-anterior position, as well as in the right anterior oblique position. The lungs, aside from the filling with barium, appeared to be normal. No evidence of pneumonia or other parenchymal disease could be noted.

The postero-anterior plates (Fig. 1) showed a definite pouch-like dilatation of the upper esophagus, with a smooth, rounded lower border, reaching to the level of the sternal notch. Below this pouch, the barium filling of the lower trachea was clearly visible, extending into the bronchial bifurcations on both sides. The further ramifications of the bronchi were also brought out, especially well on the right side. By stereoscopic study of these plates, the branching of the barium-filled bronchial distribution was seen with wonderful clearness. On these same plates, a diffuse dilatation of the upper ascending aorta, and also of the transverse arch, was observed, which resembled the aortitis due to syphilis.

* Read before the Providence Medical Association, Feb. 3, 1919.

The oblique view of the chest (Fig. 2) brought out the filling of the diverticulum especially well. Below this, the staining of the lower trachea, and the extension into the right and left bronchi, were clearly visible. The upper and lower divisions of the bronchus on the right side were easily distinguished. It will be seen that the lower border of the esophageal pouch is smooth and rounded, and does not show any irregularities or filling defects. No definite filling of the actual fistula could be made out, although a slight prolongation of the diverticulum was noted on the left side, in the postero-anterior examination. This may possibly represent the spot where the entrance is made into the trachea.

From the roentgen ray examination, a diagnosis of esophago-tracheal fistula was made. The suspicious appearance of the aorta suggested syphilis. The Wassermann reaction proved to be strongly positive. After a slight amount of antispecific treatment, the patient left the hospital against advice. Forty-eight hours later he died. The details in connection with his death are unknown. No autopsy was made.

Fistula formation between the esophagus and trachea has been familiar to the pathologists for many years. All the text-books describe the condition and its various causes. According to Adami, the causes may be grouped as due to perforation from foreign bodies, pressure from retained foreign bodies, erosion from carcinomatous or syphilitic ulcers, extension of inflammatory conditions from without, caseous tuberculous glands, and aneurism. The most common causes are carcinoma of the esophagus and tuberculosis. A very few cases have been reported in which

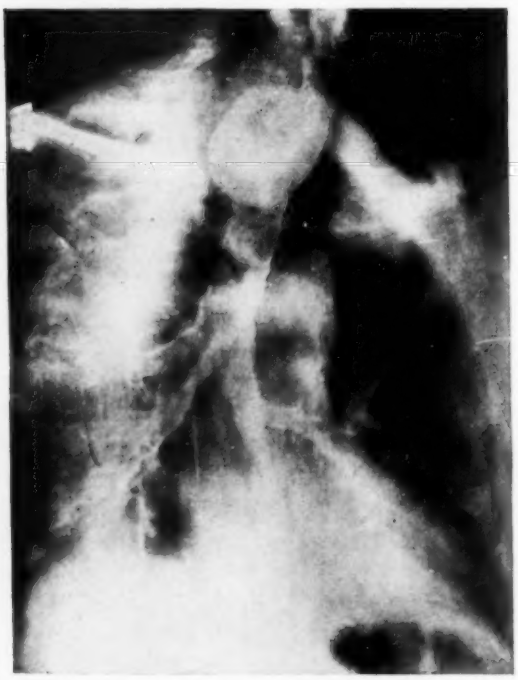


FIG. 1. ESOPHAGO-TRACHEAL FISTULA WITH DIVERTICULUM. THE DIVERTICULUM REACHES TO THE LEVEL OF THE STERNAL NOTCH. BELOW THIS, A SLIGHT BARIUM FILLING OF THE TRACHEA AND BRONCHI IS VISIBLE THROUGH THE SHADOW OF THE GREAT BLOOD-VESSELS. BARIUM-FILLED BRONCHIOLES ARE SEEN NEAR THE RIGHT BASE. THE AORTIC ARCH SHOWS THE DIFFUSE DILATATION OF SYPHILITIC AORTITIS.

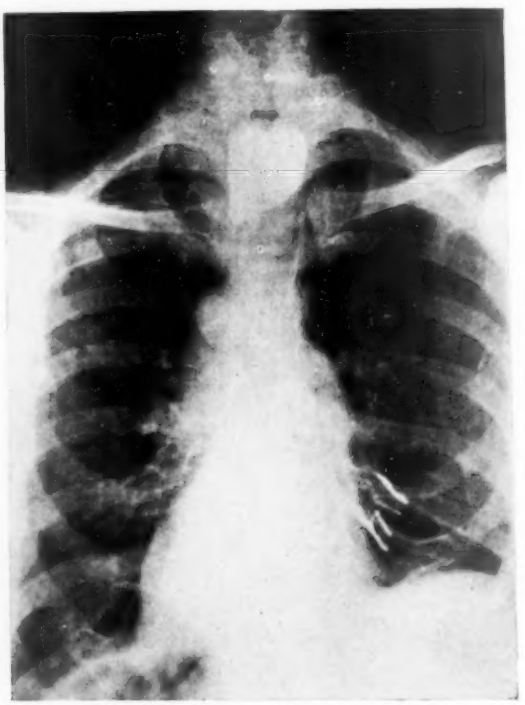


FIG. 2. VIEW IN OBLIQUE POSITION. BELOW THE ESOPHAGEAL DIVERTICULUM BARIUM IS SEEN IN THE LOWER TRACHEA AND BOTH BRONCHI, WITH THEIR SUB-DIVISIONS.

syphilitic processes in either the trachea or esophagus were found to be the basis for the resultant fistula.

These fistulæ generally lead to bronchopneumonia, from the inhalation of food or other septic material. Sometimes this results in lung gangrene. In cases of carcinoma of the esophagus, the inhaled material may be not only food but also the products of degeneration of the tumor itself. In the present case, it is remarkable that nothing pathological was noted in the lungs, either by the roentgen ray or on the physical examination, although some food particles must have been entering the lungs for at least a week. The eventual death may possibly have been due to bronchopneumonia.

Although this condition has been known to the pathologists for some time, its recognition by means of the roentgen ray is a matter of very recent development. The older German textbooks make no mention of it at all. Groedel's Atlas of "Roentgen Diagnosis in Internal Medicine," published in 1909, does not mention this pathological condition. Gocht's handbook, published in 1911, is likewise barren in this particular. Even Rieder and Rosenthal's textbook (1913) makes no mention of these fistulæ, although the section on the esophagus was written by no less prominent an authority than Prof. Paul Krause.

The British authorities have also been somewhat lax in their attention to this particular field. Barclay's monograph (1915) barely mentions the condition in passing. The otherwise admirable textbook on Radiography published by Robert Knox as recently as 1917, does not give even a line to the acquired condition of fistula formation, although he does devote a small section to the consideration of the congenital type of fistula.

The French appear to have done somewhat better. In the textbook by Jaugeas, the author devotes an admirable section to the condition of fistula as produced by carcinoma of the esophagus, and describes a case which occurred in his own practice. This is accompanied by some very satisfactory prints. He also mentions the condition as described by at least one other French author (Desternes).

Most of the descriptions appear to have been made by American observers. In 1915, Beeler described a case where the underlying cause was probably syphilis, in which he succeeded in obtaining stereoscopic plates showing the bronchial tree outlined to a certain extent by the barium mixture. Unfortunately only a very small amount of opaque meal was retained, so that the exact anatomy of the esophagus above the fistula was not made out.

The following year, 1916, Guttman and Held reported a case due to cancer of the esophagus, and one month later Carman reported another similar case. The latter was subsequently included in Carman's textbook. Guttman and Held mention a case of Horner's, published in Vienna in 1907, in which it was claimed that a fistula due to carcinoma was diagnosed in the living patient by a combination of esophagoscopic and fluoroscopic examinations. Beèler's case, however, is probably the first in which satisfactory plates were made. Ponzio, an Italian, reported a case in 1915 due to carcinoma, said to have been recognized by roentgen ray examination; but the exact details of the study are not mentioned in the review available to the writer.

In 1916, Levy of Denver reported another case of fistula. In this instance the fundamental cause was probably syphilis, although no Wassermann was taken. The suspicion was directed on account of the healed ulcers found in the trachea at autopsy, and the suspicious history generally.

Syphilis of the esophagus is not a very common condition. According to MacCallum, the primary and secondary lesions are practically unknown in this section of the digestive tract. The tertiary lesions or gummata sometimes arise in the submucosa and rupture so as to produce ulcers.

When these ulcers heal, they give rise to stricture of the canal.

In the present case, although we have no absolute pathological proof, it seems very probable that a stricture of the esophagus was slowly produced near the level of the sternal notch during the course of several months. Probably the original transient difficulty in swallowing was due to the first specific lesion in the esophagus. As the cicatrix contracted, the swallowing became more and more difficult. This particular region of the esophagus is a place where a diverticulum can be very easily produced by pressure, on account of the fact that there is a deficient musculature in the walls here, from remnants of the embryonic gill-clefts. It is at this level that most pulsion or pressure diverticula are found. In the present instance, the pressure of food taken into the esophagus against the gradually increasing syphilitic stricture was probably sufficient to produce the pulsion diverticulum. In order to explain the addition of the fistula, it would seem reasonable to believe that a later activation of the syphilitic process took place, with the production of another ulcer near the same level. This ulcer evidently perforated into the trachea about a week before the patient entered the hospital. The fact that the Wassermann reaction was very strongly positive points to the activity of the syphilis.

The age of the patient, and the fact that he was emaciated at the time of examination, might give rise to the suspicion that perhaps the fistula was not due to syphilis but to carcinoma of the esophagus. The mere fact that a syphilitic aorta and a positive serum reaction were noted does not prove that the perforation itself was due to a syphilitic process. Only recently Dean and Gregg have reported a case in which carcinoma, tuberculosis, and syphilis were found coexisting in the esophagus.

In all the published cases of carcinomatous fistula, where the condition of the esophagus is mentioned, the usual characteristics of esophageal cancer are found, namely, irregularity of the region of the stricture perhaps with evidence of infiltration of the esophageal wall by the tumor. In the present case these are absent. Instead, there is a smooth-walled diverticulum, which is much more consistent with the result of pressure against a slowly constricting syphilitic scar. The emaciation is easily explained by the lack of sufficient food taken during the course of several months.

BIBLIOGRAPHY

Adami and McCrae. Text Book of Pathology. Phil., 1914, pp. 632–625.

Barclay. The Alimentary Tract. New York, 1915.

Jaugeas, F. Précis de Radiodiagnostic. Paris, 1918.

Beeler, R. C. *Jour. Am. Med. Assn.*, 1915, Vol. LXV, 1178.

Guttman and Held. *Medical Record*, June 10, 1916, Vol. LXXXIX, 1039.

Horner. *Wiener med. Woch.*, 1907, 31.

Carman, R. D. Amer. Jour. of Roent., 1916, Vol. III, 370.

Carman, R. D. and Miller, A. The Roentgen Diagnosis of Diseases of the Alimentary Canal. Saunders Co., Phil., 1917.

Ponzio. Ref. *Intern. Centralbl. f. L. u. R.*, 1915, p. 227.

Levy, Robt. *Annals Otol., Rhinol. & Laryngol.*, Sept. 1916, Vol. XXV, p. 649.

MacCallum, W. G. Text Book of Pathology. Saunders Co., Phil., 1918, pp. 656 et seq.

Dean, L. W. and Gregg, J. B. *Annals Otol., Rhinol. & Laryngol.*, Sept. 1917, Vol. XXVI, 619.

DISCUSSIONS OF PAPERS PREVIOUSLY PUBLISHED IN THE AMERICAN JOURNAL OF ROENTGENOLOGY

OSTEOMALACIA (NOV., 1918)

DR. HOLMES.—Dr. Evans spoke of the importance of the presence of calcium in the urine as a diagnostic point. I referred to that in my paper, but probably did not lay sufficient stress upon it.

As regards the disease being confined to the lower extremities, I did not wish to state that as my belief; but one author whom I quoted did say that he considered it a disease below the belt line. Von Recklinghausen, in his very excellent work on the subject,—in fact by far the best,—calls it a general condition which may involve all the bones of the body; and I have no reason to disagree with him. Your pathologist has called attention to the fact that osteomalacia is a rare disease in this country. We both stated that it is fairly common in the Rhine Valley, and that is one of my reasons for bringing it to your attention.

MR. SNOOK'S PAPER (JAN., 1919)

DR. GRIER.—I would like to ask the speaker if making the plates with the glass side toward the patient, instead of in the usual manner, would obviate the difficulty of placing them in the stereoscope with the glass side out, which is bad because of the reflection.

MR. SNOOK.—Replying to the difficulty mentioned due to the reflections from the glass sides of the plates, I would say that the double reflections, the reflections from the glass surfaces, can easily be obviated by the proper adjustment of the blinds or curtains which accompany the ordinary commercial stereoscopes. When once the curtains are in correct position those reflections are all obviated. If they are not, take it up with the manufacturer and have him make it good. It is easy to make it good and the manufacturer will gladly correct it. When you once start the custom of using this method of viewing stereoscopic plates the comfort of vision and the ease of vision, with the lack of any misleading things that you must keep in mind, I am sure will greatly aid you. That was the only purpose I had in mind in emphasizing this idea to you. If anyone wishes to discover for himself the amount of the distortion, I have brought with me some experimental plates that I would be glad to place in the stereoscope to let you study them and to let you experiment with them to convince yourselves of the amount of the error and the amount of the distortion of which I have spoken.

When double-coated films are used, I would suggest a simple method of overcoming the difficulty. Use the little wood block with its nail as a footpoint marker in the manner I have suggested; before development take an ordinary lead pencil and mark the anterior surface of the film with the lead pencil. That lead pencil mark will stay on the plate during development and fixation and, when the plate is dried, will be on the side of the plate that was towards the *x*-ray tube.

As to the holders for the films, I am not in position to solve that problem. With respect to the tilting of the tube, I wish to say that it makes no difference whether the tube goes from here to China and around back again, or whether the tube is tilted or not, except in so far as the absorption by the glass of the bulb is concerned. As long as the focus spots are the two and one-half inches apart at the times of exposure and the field of *x*-rays gives a satisfactory image without appreciable absorption by the glass there should be and there is no difference, in the resulting stereoscopic image, as to whether the tube is tilted or not.

DR. EDMONSON'S PAPER (JAN., 1919)

MAJOR F. H. BAETJER.—Dr. Edmonson has really covered the subject so thoroughly that there is not very much to say. I only want to add one thing to what he has said; that is, in connection with the thorium injections. These injections should never be done by the roentgenologist but by a skilled urologist. If it is done by one accustomed to doing it, the results are much more satisfactory, because injecting the ureter is really a very delicate matter; and, in the second place, we minimize the danger to the patient. Fortunately, with thorium, that danger has been reduced very materially. With the injection of collargol a number of fatalities have resulted. That is one of the reasons why we look around for another medium for injection. In consideration of the kinks of the ureter, one wants

to be very careful not to mistake a spasm of the ureter for a kink. If your injection is run in at all rapidly, you are pretty apt to produce a spasm and above that spasm there may be a dilatation of the ureter, not a true dilatation, but a temporary dilatation, due to the spasm; and unless one is careful, one can mistake that for a constriction.

One other exception I would like to take to Dr. Edmonson's paper. I doubt very much, indeed, whether it is justifiable to make a routine thorium examination of the kidneys and ureters. It seems to me that that ought to be the very last thing we should resort to, because, even in the hands of the best, there is always a certain amount of danger attending this operation. It is only when all other means fail that we should resort to it.

Major A. L. Gray.—I want to say a word in regard to the importance of obtaining a knowledge of the kidney functions before operations on the kidney. Surgeons too frequently assume that the other kidney is doing its work properly without obtaining definite assurance that this is true. I am not an advocate of ureteral catheterization and thorium injection in every case, but I doubt whether it is ever excusable to remove a calculus without at least draining the ureters to determine the function of each kidney. Of course we have no statistics at hand, but it is probable that a great many fatalities have resulted from operations for the removal of calculus without knowing what the other kidney was doing.

I have in mind a prominent physician in our state who had suffered from repeated attacks of renal colic and who had a roentgen examination made for stone. He was found to have stones on both kidneys. The left kidney had a very large calculus; the right had two very small ones. Before submitting to an operation his ureters were catheterized. He was found to have three. The most natural procedure would have been to remove the large calculus. If it had been done, and that kidney materially damaged, there would have been one less distinguished physician in the state of Virginia. The other kidney, the one that had two ureters, was absolutely functionless. He is now living, in active practice and in fairly good health, with all his calculi in his kidneys.

I merely want to add a plea, not so much for the roentgenologist, because it is not his part of the job, but that the surgeons will demand kidney functions on all cases of urinary calculus which are to undergo operation.

Dr. Ashbury.—The question of iodide of potash brings to mind some studies made in the use of thorium versus the use of iodide of potash in 25 and 30 per cent solutions at the Army Medical School. Everyone realizes the value of thorium. I don't know of any ill effects reported from the use of thorium. Some time ago an article appeared in the *Journal of the American Medical Association* recommending the use of solutions of iodide of potassium and sodium in strengths from 25 to 33 per cent for pyelography. It looked good. Iodide of potash is always available and the solution is very readily made. About that time I was asked to report on the use of thorium; and in connection with our report we used iodide of potash, also. Before injecting it, however, we made some pharmacological studies by injections into rabbits and guinea-pigs. All of our rabbits died immediately following intravenous injections of about 3.7 grains of iodide of potash. Our guinea-pigs were injected subcutaneously, and developed within 36 hours an ulcer anywhere from three-quarters to one and one-half inches in size. We then stopped the investigation because we felt that the use of iodide of potash, causing such solution of the tissues, was impractical for use in the urinary tract.

Dr. Edmonson (Closing).—Mr. President, relative to the remarks of Dr. Baetjer, I want to say that he is exactly right. I would not undertake, under any conditions, the cystoscopist's task, although I have had considerable experience in catheterization. My experience with collargol is quite limited. I have never seen ill effects from injecting a ten per cent solution of silver iodide put up in quince seed emulsion. On the other hand, it has been my observation that in cases of marked pyelitis it has acted as an excellent antiseptic astringent. I have never used potassium or sodium iodide. Dr. Gray's remarks are very important. The functional test of the kidneys should always be routine work before the injection is made.

[*See* JOURNAL OF ROENTGENOLOGY, OCTOBER, 1918, p. 468.]

DR. BISSELL.—If I may presume to occupy a little more of the time of the Society, taking part of my closing time, I want to say that it is quite a disappointment to me that there has been no discussion of my paper. Perhaps it is not worthy of discussion; but when one presents a paper without borrowing, as in the present case, one usually has an object for doing so. My reason in this particular instance was that I wanted to get some of the views of this Society, for whose opinion I have considerable respect, as to the merit of the classification which I presented. It is not a thing that is developed in a few moments. I have been working on this same classification, using it for several years, and have found it practical. I believe that any man who will use something of the kind will find it a practical classification. So far as I know, in looking through the literature, I have not found any which was practical from the standpoint of the roentgenologist. There are many different classifications. Tuberculosis has been classified and reclassified, until it would seem that there was no possible classification which had not been touched; and yet, from the standpoint of the roentgenologist, all have been absolutely impractical. I would not presume to establish any standard as a practical thing if I had not worked with it rather extensively and had the advice and support of the very best clinical men.

Before the war started and our men became scattered, I had unusual support from clinicians and pathologists. We felt that by combining the roentgen observations and the clinical observations, by getting together, as it were, on those things, we could in a very early stage tell what particular type of tuberculosis we were dealing with and make our prognosis accordingly.

COMMUNICATIONS FROM THE WAR DEPARTMENT

It is requested that each officer of the Medical Corps, U. S. Army, who was engaged in the *x*-ray service and who has returned from overseas, will prepare and send to Lt. Col. G. C. Johnston, Chief, Section of Roentgenology, Office of the Surgeon General, a short description of his experiences in the *x*-ray service of the Army while abroad, for incorporation in the Medical and Surgical History of the war. Due credit will be given to each author for the portions of his narrative used. The history of the *x*-ray service will thus be written by those men who helped make it. In reply refer to S. G. O. 700.7.

MEMORANDUM for Editors of Medical Periodicals.

As stated in the circular memoranda for Editors of Medical Publications issued by the Surgeon General's Office on March 27th and May 22, 1918, it is required by paragraph 423, Manual of the Medical Department, that all medical manuscripts by medical officers, U. S. Army, intended for publication shall be first submitted to the Surgeon General's Office, Washington, D. C., for approval. This regulation, which has been very courteously complied with, to date, is still in force as far as medical officers on active duty are concerned. In the case of medical officers recently retired from active duty, it is requested, as a courtesy to the Surgeon General and in aid of assembling material for the Medical History of the War, that all medical manuscripts based upon military or official records or upon military experience during the War, be submitted as heretofore, to the Secretary, Board of Publications, Surgeon General's Office, Washington, D. C., for record and approval and that such MSS. be accompanied by a carbon copy. Upon approval, the original copy will be forwarded to the journal designated, for publication, and the carbon will be filed in the records of the Medical History of the War.

For The Surgeon General:

(Signed) C. R. DARNALL,
Colonel, Medical Corps, U. S. A.,
Executive Officer.

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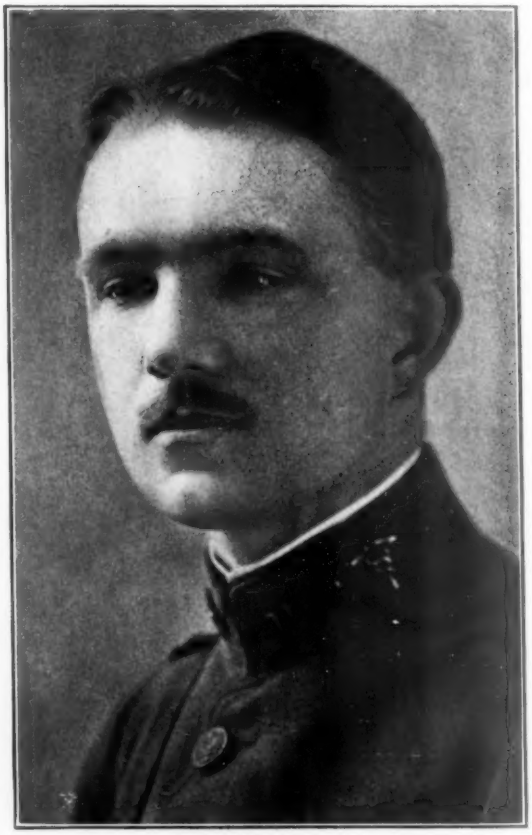
JAMES W. SQUIRES

The death of Capt. James W. Squires of Charlotte, N. C., which occurred December 16, 1918, at the Justice Hospital Group in Toul, France, deprives the South of one of the most highly prized and ablest of the younger medical men of that section. Capt. Squires went to France as Roentgenologist with the Yale Mobile Hospital Unit August 21, 1917. Prior to joining his Unit he received military training for two months at Fort Oglethorpe, Ga., later being detailed for some intensive roentgen ray work at Cornell University. Arriving in France Sept. 17, his Unit marked time at Limoges, Haute Vienne, and then proceeded to the Lorraine Sector where Capt. Squires by unremitting energy and skill set up and operated (first at Aulnois, later at Chaillon) equipment of French pattern coördinated into a field-plant which was second to none in any of the combat zones. By September, 1918, just prior to the St.



Mihiel offensive, he received the full American equipment. At this time, he and his half dozen assistants had in operation three sets of rooms fully equipped giving direct access to the operating pavilion, besides manning a bedside equipment. The chief of this remarkable localization service,

installed at a distance of only six miles behind the enemy lines, gave himself too unreservedly to his task of orienting the surgeons. The operators could handle 200 cases a day, and this, with multiple localizations practised on patients difficult in the extreme to manipulate, put a death-dealing strain upon the chief roentgenologist. Capt. Squires fell a prey to lobar pneumonia and died on the very evening that his Unit received the first intimation of its return home.

Born November 2, 1888, at Matthews, N. C., James Williamson Squires lived in Charlotte from his fifth year. He graduated from the High School there in 1906, at the head of his class, and from the North Carolina Medical College in 1911, with a four-year standing of 93.5. On April 12, 1912, he married Eunice V. Jeffries, who bore him a second son on the day he sailed for France. In 1913 he took the course in roentgenology at Johns Hopkins, where already, as a North Carolinian undergraduate, he had taken some postgraduate work in medicine. In fact he had shown great assiduity as a postgraduate student, having worked at the New York Post-Graduate Hospital and Rockefeller Institute the year of his marriage. This competence as a student and deft efficiency as a technician were accompanied by a never failing courtesy and kindness of heart which won for Dr. Squires an immediate success at home. He developed his technique; by leaps and bounds knowledge grew in him concerning the "Ars et Mysterium" of roentgen ray. In practice he was associated with his uncle Dr. A. J. Crowell, who showed a parental devotion to him throughout his busy brief career. The death of Capt. Squires is a heavy loss to that large section of the Carolinas which in life he served, and to the American Roentgen Ray Society of which he was a most lovable and able member.

TRANSLATIONS & ABSTRACTS

SAMPSON, H. L., HEISE, F. H., and BROWN, LAWRASON. From the Trudeau Sanatorium, Trudeau, New York. A Study of Pulmonary and Pleural Annual Radiographic Shadows, Together with Notes on Interlobar Fissures. (*Am. Review of Tuberculosis*, 1919, Vol. II, No. 11, p. 664.)

The authors set out to show that many annular roentgen-ray shadows are not intrapulmonary cavities, as they have been described in a number of articles dealing with silent or unrecognizable cavities, but are in reality in many cases interlobar pneumothoraces or hydropneumothoraces and intrapleural. They may be situated between the lung and the chest wall.

A brief summary of the literature follows relating the specific clinical signs present in prevalent interlobar pleurisy. Following this, the roentgenographic study of intrapulmonary cavities is taken up in the following text: "That nearly all intrapulmonary cavities cast either a simple rarefication or a 'rarefication complex' on the plate or screen is quite probable. Whether or not these areas of greater transmission of ray are seen depends upon the size, shape and position of the cavity and the density and character of the adjacent tissue. There is probably no single roentgenographic manifestation or combination which is diagnostic. . . .

"The absence or marked diminution of lung markings inside an area or areas of rarefication is the most dependable, and if the size and position of such an area or areas are taken into account a diagnosis of cavity can be made with much assurance. . . .

"A somewhat circumscribed area of rarefication inside a consolidation or marked infiltration is also of much value and fairly reliable. . . .

"A manifestation that leaves one in much doubt as to its diagnostic value in relation to intrapulmonary cavity is the annular or ring-like shadow, varying in shape, seen many times in normal or mildly infiltrated lung fields, and it is this picture that we have attempted to investigate. . . . Many times more ray is absorbed inside these annular shadows than in the surrounding lung tissue; in a small percentage of cases more ray is transmitted through this ring; while in about 60 per cent of instances the transmission is the same. Lung markings are profuse in many of them even when the size is extreme, occupying an entire apex or upper third. . . .

"The profusion of lung markings, the greater or equal absorption of ray through these annular shadows, and also the fact that certain of them change their shape and size rapidly, make one skeptical as to their value in the diagnosis of intrapulmonary cavities. In many instances some as large as 3 to 5 cm. disappeared in from three to six months, or became larger and then smaller and finally disappeared."

The following table is given to illustrate the changes noted by the authors in fifty cases studied:

Enlarged, 18 per cent. Appeared where not previously present 20 per cent.
Diminished, 26 per cent. Increased and then diminished, 14 per cent.
Disappeared, 14 per cent. Change not known, 40 per cent.
Remained the same, 4 per cent.

"The character of these annular or ring-like shadows varies exceedingly. At times they are like a ring of dense fibrous tissue; at other times like a circular deposit of fibrinous exudate; and lastly they may also appear fairly broad (ribbon-like) and homogeneous. In many instances the lower margin is horizontal (possible fluid level). Seventy per cent of these shadows are above the third rib; the rest are scattered anywhere in the lung field."

In 423 consecutive cases annular shadows were found in 50 cases, or 11.8 per cent.

A most important contributory paragraph in this paper deals with a clear description of the course of the pulmonary fissures, which is in turn graphically illustrated by drawings and photographs of the location of lobes and fissures of the lung.

Physical signs of intrapulmonary cavity are discussed, and special emphasis is laid upon those cavities which contain fluid and air.

"A comparison of the physical signs, symptoms and other findings was made in the fifty cases showing these annular shadows in com-

parison with the clinical findings in another series of fifty cases where the annular shadows were not present. Both series were composed of cases with definite parenchymatous lesions. Pleuritic onsets and those with hemoptysis were of approximately the same frequency in both classes. Pleurisy with effusion occurred in only six per cent of the cases with annular shadows as against 14 per cent of those without. Dry pleurisy occurred with equal frequency.

"Physical signs of infiltration, or signs which could be interpreted as evidence of consolidation or cavity, occurred with equal frequency in each class of cases. Râles likewise occurred with equal constancy in both classes.

"Hemoptysis, however, occurred in a greater number of those cases that did not have the annular shadows. Yet on the other hand, streaked sputum without hemoptysis occurred more frequently in the cases showing annular shadows, 28 per cent as against 14 per cent without.

"The appearance of tubercle bacilli in the sputum played no rôle. 'The cases with annular shadows showed a greater tendency to relapse, a rather serious relapse occurring in 24 per cent of those with, and in only 8 per cent of those without.'

SUMMARY AND CONCLUSIONS

"This study of fifty cases, unselected from a much larger number, has led us to conclude that annular shadows, surrounding areas of increased or equal absorption of the ray, occur in patients more likely to be suffering from pulmonary softening, and indicate rupture of the lung.

"Owing to the presence of adhesions only partial pneumothorax with or without fluid results. The site of the pneumothorax depends upon the location of the softened focus and usually occurs in the upper part of the greater oblique fissure and in the horizontal fissure on the right. These pneumothoraces can rarely be diagnosed clinically and indicate a somewhat graver prognosis."

Beautiful photographs illustrating the lobes and fissures, and roentgen ray reproductions showing numbers of these ring-like shadows, accompany the article.

CHARLES A. WATERS.

COLLIN, E., PONTOPIDDAN, B., AND SCHOU, H. I. Light in Treatment of Tuberculosis of Bones and Joints. (*Ugeskrift for Læger*, Copenhagen, Nov. 21, 1918, 80, No. 47. Ref. *Cur. Med. Lit.*, Vol. 72, No. 6, p. 462.)

Collin declares that rational phototherapy is still in its infancy, notwithstanding the great advances made in recent years under the leadership of Finsen, Rollier and Reyn and Ernst. The two latter in the last five years have demonstrated that the light treatment alone, without the co-operation of climatic influences, cured as effectually at the Finsen Institute at Copenhagen as Rollier's mountain climate sunbaths. They proved that artificial light can take the place of sunlight from the therapeutic standpoint. The arc light rays seem to be more potent than any other source of radiant energy, although some prefer the quartz mercury vapor light. As the latter is less expensive to install, the two seashore sanatoriums for tuberculous children in Denmark are equipped with this, and Collin here reviews the experiences with 138 tuberculous children given this treatment after they had failed to show improvement under the general measures alone. They were thus the severer cases; in 102, general light baths were given, in 52 merely local, and in 34 regional baths, in some associated. The average length of the course of light treatment was five months; the range was from six weeks to ten months. All this material is described in detail, with the technic shown in illustrations and the outcome.

Recent re-examination shows that there has been recurrence in 13 of the 138 cases; in 11 of these 13 cases the course of phototherapy had been less than two months. Evidently the treatment was arrested before it had answered its complete purpose. In the remaining two cases, the children had other tuberculous lesions besides those that had been treated. The results in the total 138 cases must be regarded as extremely favorable. The seashore environment may have contributed, but as this alone had shown no benefit beforehand, it need not be taken much into account in estimating the outcome. The relatively rapid cure, the absence of disfigurement and the good functioning of the limbs are special advantages of this phototherapy. The experiences related impress the wisdom of sending children with tuberculous processes in glands, bones or joints to a seashore

sanatorium and supplementing the ordinary measures with courses of light treatment, sunlight, arc light or quartz lamp.

In 108 cases the tuberculous lesions seem to be cured; in 20 there was great improvement, and in 12 others some improvement. No benefit was observed in 16 cases and the lesions progressed in four; these were cases of spondylitis or white swelling of the knee. All of the gland cases and tendon sheath cases and cold abscesses were improved or cured. The children were between 4 and 15. In one case ichthyosis subsided under the light treatment applied for a tuberculous process. The children sometimes develop fever under the exposures, and recurring febrile bronchitis was not infrequent. The latter may have been the result of chilling during the exposures—the quartz lamp does not generate much heat—or it may have been from activation of latent tuberculous peribronchitis. There was complicating pulmonary tuberculosis in six cases, and in four the exposures had to be suspended as the condition was aggravated by them. This group includes the two spondylitis cases. Keratoconjunctivitis developed in 12 cases, and he queries whether this was due to injury of the eyes from the light, or activation of a latent process, or the result of the universal reaction to the toxins. The latter seems to him the most plausible explanation. An epidemic of varicella in the sanatorium did not spare the exposed children, and the pustules seemed to be extra large in them, resembling actual variola. Erysipelas developed in five cases, apparently uninfluenced by the phototherapy.

CLARK, WILLIAM L., Philadelphia. Cancer of Oral Cavity, Jaws and Throat. (*Jour. of A. M. A.*, Oct. 17, 1918.)

The author has, after study of the results of treatment in about 200 cases, found what a great success the electrothermic coagulation method has had, alone as well as combined with roentgen rays, radium, and surgical interference. He came to the conclusion that one electrothermic operation was sufficient for the destruction of malignant tumor in the oral cavity and the pharynx.

The methods used are the electrodesiccation and electrocoagulation; the first does not produce so intense a heat as the other, and is best suited to the destruction of such small, localized growths as may be found on the vocal cords, etc. By electrocoagulation a very penetrating and intense heat is produced, and is utilized for the destruction of the larger growths and also for bony involvements. Both methods are produced by high frequency currents and applied by steel needles that might be sharpened for the purpose.

If the parts involved cannot be exposed sufficiently by means of retractors or mouth gags, surgical measures must be practised, and extirpation of the gross mass of malignant tumor is also done by means of surgery, with electrothermic treatment following immediately to check hemorrhage and further destroy tumor tissue; also cervical glands can be removed followed by roentgen ray treatment in this region to prevent recurrency. Roentgenotherapy and radiotherapy following diathermy have proved to be very beneficial.

The author found that most cases of cancer of the mouth occur in males, especially where the oral toilet has been neglected and bad dental work and excessive smoking have caused a chronic inflammation. Cancer is also often found in combination with lues and tuberculosis.

Success in this treatment is only obtained where there is no cervical metastasis and where an absolute eradication of the last spot of diseased tissue is produced.

In most of the 200 cases treated, roentgen rays and radium had been used previously without success.

The 200 cases were divided into two groups; first, those distinctly localized with a favorable prognosis, and second, the conditions with metastasis to still movable cervical glands with a rather guarded prognosis. The numerous badly advanced cases with extensive primary lesions, adherent glands and involvement of other organs were treated without any thought of cure.

The author charted up the cases treated following anatomical locations. The best results were obtained in cases of localized involvement of the lower lip, while carcinoma of the tongue and larynx and surrounding organs showed a tendency to recurrence. In cases with metastasis recurrence was the usual thing; but if the lesions occur only locally there is always a chance for cure and success.

P. M. LUND.

GRANGER, AMEDEE. Improved Model of the Granger Localizer. (*Am. J. Electrotherap. & Radiol.*, April, 1918. Original presentation *New Orl. M. & S. J.*, Jan. 1918.)

The author describes his instrument, which applies the well-known parallax principle of foreign object localization. Its use simplifies the operation of obtaining equal shadow shifts of the foreign object and the auxiliary body (parallax indicator) which must be obtained in the determination by any parallax adaptation of the plane upon which the object lies.

An aluminum base has three wires placed lengthwise, the center one of which is in the center of the base, the other two parallel to it an equal distance on each side. Three shorter wires lie across these, the center crossing of which forms a central cross. The base is adjustable with reference to an upright support or post which carries two arms, a parallax indicator and a horizontal screen support. A scale is graduated on the upper surface of the base, zero of which is the central cross. A somewhat similar scale is found on the upright post; the sleeves supporting the two horizontal arms permit vertical and horizontal movements.

In use, the base of the instrument is inserted between the underside of the patient's skin and rests upon the table surface. The shadow of the foreign object being found, the center cross of the base is brought to lie in vertical line with the projectile, using a narrowed diaphragm, and the pierced center of the screen is likewise brought to the same line. The diaphragm is now opened and the tube displaced to right or left until the shadow of the projectile falls upon the shadow of the lateral wire. The parallax indicator is raised or lowered until its shadow falls upon the same lateral wire shadow as that of the projectile. The parallax pointer is now upon identically the same plane as that of the foreign object, and the distance from the underskin surface may be read upon the upright scale. The parallax pointer is next advanced horizontally until it touches the skin. With the screen resting upon the patient, the distance to the projectile is obtained by subtracting the distances of upper and lower sleeves from the base. The parallax pointer is then dropped to the base and its end compared with the scale on the base, which will indicate the distance laterally from the skin to the projectile.

The instrument is light, convenient and easily applied, and gives accurate measurements of these distances.

E. S. BLAINE.

DANDY, WALTER E. Fluoroscopy of the Cerebral Ventricles. (*Johns Hopkins Hosp. Bull.*, Feb., 1919, Vol. XXX, 336, 29.)

With the appearance of this paper another decided mark of advancement has been added to surgery and roentgenology. "Fluoroscopy of the Cerebral Ventricles" is the second paper to appear by Dandy on outlining the cerebral ventricles by the withdrawal of cerebrospinal fluid from the ventricles by means of a long needle and two-way syringe and replacing the fluid withdrawn by air.

The author claims that the results have been quite as striking from a fluoroscopic point of view as those seen on the roentgen-ray plate. The ages of the patients examined under the fluoroscope have ranged from three months to fifty-five years. The ventricles were found to be almost as distinct in adults as in infants and young children, though harder rays were necessary in order to penetrate the thicker skulls.

From 20 to 350 c.c. of air were introduced into the ventricles in his series of cases.

As in other things a combination of two methods is often better than any single one, and the fluoroscopic method combined with the plates is advocated by the author, claiming that the fluoroscopic study yields the same results as a series of ventriculograms; by proper movement of the head, antero-posterior and profile views or any part of one or both of the lateral ventricles can be studied, and a composite picture of the ventricular system obtained. However, if the fluoroscopic method was adopted to the exclusion of the plates, no permanent or graphic records of the cases could be had. And further the interpretations made at a fluoroscopic examination are necessarily hasty impressions and depend largely upon the individual's personal equation, especially when the observer's experience is limited and the normal and pathological not well established.

The technique of the injection of air has been described in the first communication by Dandy on this subject.

The author does not make himself quite clear in the paragraphs given to technique, although he undoubtedly advocates the horizontal fluoroscope with the patient prone, rather than the upright and standing or sitting position. Each movement of the head temporarily disturbs this fluid level, which quickly reforms with rest, just as in pneumothorax. Since only part of the fluid in the ventricles is usually replaced by air, it is evident that the position of the head will determine the part of the ventricular system that will contain air or fluid at a given time. The movements of air in the ventricles is more difficult than in hydropneumothorax, because there are curves, angles and branches of the lateral ventricles and points of narrowing at the foramina. Since the lateral ventricles are paired and communicate only anteriorly through the small foramina of Monro, these difficulties become greater.

Beginning with a small amount of air in the descending horn of one of the lateral ventricles, by changing the position of the head one can observe the air passing into the posterior horn, then the body, the anterior horn through the foramen of Monro into the third ventricle. From the third ventricle it passes through the opposite foramen of Monro into the opposite lateral ventricle, and by reversing the movements of the head the air may be sent to the descending horn of this ventricle. The rapidity of transfer of fluid from one lateral ventricle to the other varies with the size of the foramina of Monro.

In advanced hydrocephalus much additional communication between the lateral ventricles results from large perforations in the septum lucidum due to absorption from increased intraventricular pressure. In normal or moderately enlarged ventricles there is an uneven distribution of air in the two lateral ventricles when viewed anteroposteriorly. Only in large ventricles with very large foramina of Monro or in which there are artificial openings in the septum lucidum, is the communication between the lateral ventricles ample to give an equal distribution of air on the two sides without careful manipulations of the head.

In advanced hydrocephalus, the two cavities are practically fused into a single space, so that the fluid in the two sides quickly assumes the same level.

The results from this method of study have been practically the same as from ventriculography. Either by ventriculography or fluoroscopy the dilated ventricles are pathognomonic.

Five cases are cited in the results of this work along with well chosen illustrations. Several times air was seen in the cisterna magna indicating the patency of all the ventricular foramina, but so far it had not been observed in its passage through the aqueduct of Sylvius and fourth ventricle. Normal sized ventricles were observed, and aside from the difference in size of the ventricles the air passes from one side to the other much slower, and more careful manipulations of the head are necessary to accomplish the transfer.

CHARLES A. WATERS.

BROWN, GEORGE E. Syphilitic Aortitis and its Early Recognition. (*Am. J. Med. Science*, Jan., 1919.)

The author gives an historical and pathological résumé of the subject. He points out the frequency with which the condition is overlooked during life, and the large percentage of cases diagnosed at autopsy. He shows the importance of a careful clinical examination, and states that the roentgen examination is by far the most important method for demonstrating changes in the aortic arch.

The following changes can be demonstrated by means of the roentgenogram:

1. Enlargement of the aortic shadow to the right. This is usually the earliest demonstrable change, as it is the portion of the aorta first involved in the syphilitic process.

2. Enlargement to the left, with obliteration of the normal aortic knob.

3. Enlargement both to right and left. Increased density of the aortic shadow is suggestive, as is also the reduction of the aortic pulsation when viewed fluoroscopically.

The author states that the normal aorta of a young adult man should measure five to seven cm. in the transverse diameter, and at the age of fifty years eight cm., somewhat less in women.

He believes that by use of a carefully prepared clinical record, plates taken in upright position at a distance of from six to seven feet, and a Wassermann test, we shall be able to diagnose early syphilitic aortitis in a larger percentage of cases.

He concludes with an analysis of seven interesting cases showing that an early diagnosis should not be based on any one method used alone, but by a conjunction of the various methods.

J. H. MULLER.

PIRIE, A. HOWARD, Major, C. A. M. C. Localization of a Foreign Body in the Eye. (*Arch. Radiol. and Electroth.*, Nov., 1918.)

In this article the author reviews the various methods of eye localization, points out errors in the various methods used, and suggests a ball and mirror method of localizing foreign bodies in the eye which is mathematically accurate.

The following conclusions are arrived at:

In Sweet's method with a plate focus distance of 50 cm. and a 10 cm. shift parallel to the plane of the plate, a foreign body in the posterior pole of the eye is located 3 mm. too far back, a foreign body in the upper pole is located 1 mm. too far up, and a foreign body in the nasal pole is located .69 mm. outside the the eye. He then describes the ball and mirror method of localization. The apparatus is simple, accurate and inexpensive, consisting of a steel right angle, having attached to it a fixed ball and a small mirror, so that the adjustment can be accurately and quickly made. Two exposures are made and both instrument and foreign body are projected upon the one plate.

From the resultant negative one is able to tell the points perpendicularly above which the rays came from when each exposure was made; the tube shift, the point perpendicularly over which the ball lay, and the point perpendicularly over which the foreign body lay.

From the data, by means of triangulation and direct measurements, one can accurately locate the position of the foreign body.

The author also shows a table of measurements, made at a plate focus distance of 50 cm. and a tube shift of 20 cm. from which one can make direct readings if the same plate focus distance and shift have been used.

Having determined the position of the foreign body in the various planes it is necessary to know whether the foreign body lies within the eye. This can be done in various ways, by slide rule, model or a diagram table. The author advises the method suggested by Capt. Taylor, and publishes the table from which one can readily make direct readings.

J. H. MULLER.

(1) HARDY, WILLIAM F., St. Louis. Ocular Diseases of Dental Origin. (*Amer. Jour. of Ophthal.*, April, 1917, Vol. III, No. 3.)

Hardy's article is a partial review of the literature of this subject accompanied by what appears to be a fairly complete bibliography. The following remarks towards the end of the article seem worthy of transcription:

"The argument is raised that the connection between tooth and eye affections is too hypothetical and problematical, and that they are not related in cause and effect, but are coincidental. This view is based on the great prevalence of tooth affections and the relative infrequency of an associated eye disease. But the same is true of syphilis, gonorrhœa, and tuberculosis. How common are these and how relatively infrequent are ocular diseases the result of them. Yet no one disputes a syphilitic, gonorrhœal or tuberculous iritis or keratitis. It is incumbent upon ophthalmologists to consider the teeth in our list of possible ætiological factors, but to refrain from making of this possibility a hobby to be ridden to death." These remarks seem very much to the point.

(2) DOR, L., Lyon. Optic Neuritis Due to Dental Infection. (Névrite Optique par Infection d'Origine Dentaire.) (*La Clin. Ophthal.*, Sept., 1917.)

Dor has already given expression to his views on the subject of eye disease due to dental infection. He here adds reports of two cases which he holds are of this origin, though the case histories are incomplete in so far as the result of treatment of the teeth is not mentioned. He says that certainly readers are free to think that there is a simple coincidence between ocular affections of an "indeterminate" nature and the dental affection, but that those who consider the evolution of such cases of optic neuritis before and after the extraction of the teeth will quickly be convinced of the relation of cause and effect.

(3) Dor, L., Lyon. Thrombosis of the Retinal Veins Due to Dental Infection. (Thrombose des Veines Rétiniennes par Infection d'Origine Dentaire.) (*La Clin. Ophthal.*, Sept., 1917.)

Dor relates the case of a soldier who had thrombosis of the central vessels of the right eye with retinal hemorrhages and amblyopia ex anopsia of the highly myopic left eye. There was neither sugar nor albumin in the urine and no sign of syphilis. The dental condition was very bad on the side corresponding to the thrombosis. Four teeth with infected roots were extracted from this side of the upper jaw. The case is incomplete in so far as there are no observations as to the result, but Dor himself is satisfied as to the cause of the thrombosis being purely dental.

Ernest Thomson.

(3) Freund, L. Electric Diagnosis of Internal Ulceration. (*Deutsche med. Wchnschr.*, Dec. 5, 1918, 44, 1345.)

The writer calls attention to the information that is to be derived from the sharp local pain felt when a weak faradic current passes through any excoriation. He utilized it to detect any break in the skin in his hands before operations. He dipped his hand in the fluid of the hand jar of the "four cell electric bath" for arms and legs. The twinge of pain from even a hangnail showed at once the points to be protected with collodion. The method is applicable to the body cavities, stomach, bladder, rectum and vagina. For the stomach, he introduces a fine copper wire inside the stomach tube into the stomach, and passes a roller electrode over the surface of the body outside. The patient first drinks the barium contrast suspension, as roentgen examination usually is done at the same time. This thick suspension prevents any injury from the wire guide in the rubber tube. In sixteen persons thus tested, five complained of sharp pain at one or more points in the anterior wall of the abdomen. One of this group had a laparotomy later, and evidences were found of a healed invagination. The nine who responded negatively to the test were all clinically sound except one man with an atonic sagging stomach.

Taylor, Herbert D., Witherbee, William D., and Murphy, James B. Studies on *X*-ray Effects. (*Jour. Exp. Medicine*, Jan., 1919.)

1. *Destructive Action on Blood Cells.*—In order to determine the response of the blood cells to the roentgen ray, the authors gave fairly large doses to a series of susceptible animals. The animals used were the cat, monkey, guinea-pig, rabbit, rat, mouse and pony. Their susceptibility to the roentgen ray was found to be somewhat in the order just given. The most remarkable effect was a sudden decrease in the circulating lymphocytes. It appears, from their charts, that the total number of lymphocytes per c. mm. of blood, as determined by multiplying the total white count by the combined percentage of small and large lymphocytes before and after roentgen ray treatment offers a fairly accurate indication of the effect of the roentgen ray upon the blood. If this total number of circulating lymphocytes is plotted against the time in days, a curve is formed which reaches its lowest level 48 hours after the administration of the roentgen ray. There then follows a primary rise which reaches its height from 3 to 5 days after the last roentgen ray exposure. A secondary fall then occurs, which reaches its lowest level from 5 to 12 days after treatment, and this is followed by a secondary and, as far as could be determined, a permanent rise which persists for at least 6 or 7 weeks.

When the roentgen-ray treatments are distributed over a number of days, the results in the curve are somewhat confused because of the overlapping phases. In this case the primary fall in the circulating lymphocytes in the case of the animals given roentgen rays in several doses is really the result of a series of primary falls, and other phases may be somewhat lengthened.

It was found that animals of the same species respond to the same dose of the roentgen rays almost quantitatively.

When the lymphocytes are studied in terms of percentage of the total white blood cells, the results are not so striking. While in most instances their results showed a definite fall in percentage as well as in actual numbers of these cells after roentgen ray treatments occasional instances were encountered where the percentage change was slight or absent. This

they interpret as due to the fact that while in most instances the roentgen rays affect the lymphocytes selectively, occasional cases are found in which the granular blood cells are also destroyed.

The primary fall is accounted for by the destructive action of the roentgen rays on the lymphocytes as first experienced in the general circulation and in the sleep. In the meantime, the lymphogenic cells of the other organs, lymph glands, bone marrow, etc., contribute cells to the blood, these being responsible for the secondary transient rise. When all the lymphogenic tissues have been affected, the secondary fall in these cells is noted, but the low level characteristic of the primary fall is not reached because of beginning regeneration in the spleen. The permanent rise represents regeneration of all the lymphogenic tissues.

The polymorphonuclear neutrophiles have a tendency to show a slight primary rise 24 to 48 hours after treatment. This is followed by a primary fall which reaches its lowest level any time when the lymphocytes are beginning to rise. Later there is a gradual rise to normal. These cells are much less affected by the roentgen rays, and after the primary stimulation and later depression the return to the normal number per c. mm. occurs at a time when the lymphocytes are still at a very low level. Circulating eosinophils and basophils as well as large mononuclear and transitional leucocytes, usually share in the stimulations and depressions of the neutrophilic cells. This is as would be expected, as they all belong to the granular series and originate in the bone marrow which is later affected by the roentgen ray.

Summary.

1. Roentgen rays in large doses affect the lymphocytes before any of the other circulating cells.

2. There is a sharp fall in the total number of circulating lymphocytes, which is completed forty-eight hours after roentgen-ray treatment.

3. Following the immediate decrease in the circulating lymphocytes, there is a primary rise, followed by another fall, which in turn is followed by a permanent rise of these cells to normal.

4. The effect of the roentgen rays on different species of animals varies considerably, but in those studied, cat, monkey, guinea pig, rabbit, rat, mouse and pony, the selective action on the lymphocytes was in all instances apparent.

5. When several animals of the same species are given the same dose of roentgen rays, the effect on the circulating lymphocytes seems to be quantitatively parallel, when determined by blood counts.

6. The polymorphonuclear neutrophilic leucocytes, when affected at all, increase in number immediately after the administration of the roentgen rays and then tend to decrease below their normal level. This decrease is followed by a return to normal many days before the lymphocytes reach their original level.

7. The other cells of the blood follow the neutrophilic curve.

8. Percentage figures, as determined by differential blood counts, do not give an accurate indication of the effect of the roentgen rays. It is only when these are multiplied by the total white blood count that a figure, representing the total number of cells of the series per c. mm. of blood, is obtained, which varies to the stimulus in a constant manner, the variations being practically quantitative.

2. *Stimulative Action on the Lymphocytes.* While large doses destroy lymphoid tissues and produce a decrease in the circulating lymphocytes, small doses bring about a stimulation. The authors conducted two series of experiments, using brown rabbits. In the first series a dose of low penetration was applied to the dorsal area; spark gap 7/8 inch, milliamperage 25, target distance 8 inches, exposure time 20 minutes. In the second series filtered rays of higher penetration were used: spark gap 6 inches, milliamperage 5, target distance 10 inches, time 26 minutes and 57 seconds, three mm. illuminum filters. The animals of both series were otherwise exposed under identical conditions. The result showed that the roentgen ray dose of low penetration produced a definite stimulation which reached its maximum in from four to seven days after the rays were administered. The use of the largest spark gap with apparently the same dose, did not give a stimulation.

From their results, the authors suggest that the effect on the lymphoid organs is not the result of a direct action of the rays, but is brought about by secondary changes either in the circulating blood or in the superficial tissues; since the amount of roentgen ray of this

penetration reaching the deeper structures would be infinitesimal.

The difference in response of the individual animals is no more than that shown by individuals with normal counts who react differently in the number of cells thrown into the circulation in response to infections. They also note that it is conceivable that a marked stimulation may be taking place in the lymphoid organs without a proportionate number of these cells being thrown into the circulation.

3. *Changes in the Lymphoid Organs After Small Doses of Roentgen Rays.* "Iden. Ware Nakahara, Ph.D."—The author used the same dose of roentgen rays as used in the previous series. Animals were killed at intervals and tissues taken for study. Stimulation in the spleen becomes evident shortly after treatment and reaches its maximum in about four days persisting in a slight degree up to about fourteen days. The reaction in the lymph glands is somewhat quicker, appearing immediately after treatment and reaching its maximum in about two days. The small dose used had no appreciable destructive effect on the lymphoid tissues. The findings are compared with those observed in lymphositosis produced by heat. The author points out, however, that while apparently similar in nature the two phenomena are really different in that the lymphocytosis produced by heat is a sort of regenerative phenomenon, whereas that induced by the small dose of roentgen rays is due to the primary stimulative effect of the agent.

4. *Direct Action of Roentgen Rays on Transplantable Cancers of Mice.* "Iden. Hill, Elias; Morton, John J.; Witherbee, Wm. D." The authors selected the mouse cancer (Bashford Adenocarcinoma No. 63) and followed it through about fourteen generations of mice; half of the series was roentgen rayed between each transplantation. Their results seemed to show that while in the first few members of the series the percentage of takes was reduced and time of appearance was increased, in the later members of the series no appreciable difference was noted. In view of the fact that a proportion of cancers held in check for a time for roentgen ray treatment will later grow more rapidly, they raise the question as to whether workers in roentgen-ray therapy are justified in using a procedure which apparently only inhibits the cancer temporarily, while it incidently lowers the resistance of the individual to the growth.

A second series of experiments using less penetrating rays seem to show that rays of low penetration were apparently more harmful to the tumor cells than the more penetrating rays used in the first series.

HERMAN OSGOOD.

Radium in Cancer of the Upper Air and Food Passages. (*Revista Española de Medicina y Cirugia*, Dec. 1918. *Med. Rec.*, March 15, 1919, p. 457.)

Botey has used radium for these conditions since 1906, having begun with cancer of the nose. In superficial cutaneous epithelioma of the latter, excellent results are obtained by the use of radium in sessions of 30 to 60 minutes each. Ordinarily half a dozen sessions at intervals of 4 to 7 days suffice for cure. Of intranasal growths treated the great majority were sarcoma or myxosarcoma. Direct applications were made with but little filtration. A Dominici tube enclosed in one of brass is supported with a tampon, and left in the nose for from 6 to 24 hours. After 3 or 4 sessions the sarcomatous tissue melts away. Instrumental removal of parts of the tumor may be used in association with radium. Recurrence sometimes occurs but may be retarded by radium. In endonasal epithelioma results are mediocre, and this is also true of the same lesion in the mouth with occasional exceptions. In the fauces the only growths to be benefited are fibroadenomas. In malignant growths in this region any benefit is transitory. As for the larynx it has always been impossible to maintain a tube in its interior and the growths here are attacked through the skin. But results are poor and the author has spent much time in perfecting a technique in which intubation with or without tracheotomy serves for the introduction of a radium tube. He has made numerous applications of radium in this manner in which the external application is added as synergist. There is a conflict here because on the one hand the tolerance of the larynx for this treatment is limited and on the other hand large doses are in theory indicated. The reactions of the tissues are hostile to the development of the growth and favor autolysis of the cancer cell as well as production of fibrous tissue. It is believed, however, that radium sometimes favors re-

currence and all in all the author would limit this treatment to small and circumscribed lesions. Radium after extirpation despite its alleged unfavorable action on extensive growths in the direction of recurrence is also held to prevent the first beginnings of recurrence, this duality being difficult to comprehend. In tumors of the esophagus radium is an excellent palliative. The author treats cases of this nature by the application of tubes with the aid of the esophagoscope for the space of about 6 hours, repeating after an interval of from 4 to 7 days. The size of the tube is increased progressively. The sound and catheter can be used as the growth recedes.

SHOHAN, J. On the Need of More Frequent Roentgenological Examinations, Particularly in Head Injuries. (*Boston Med. & Surg. Jour.*, Feb. 27, 1919.)

The importance of roentgen examinations immediately after injury, is discussed, especially from the sociological standpoint. The relationship which fractures of the skull bear to epilepsy and other diseases is used as the base of the argument. The fact that fractures of the skull can seldom be made out after a certain length of time is emphasized.

SMITHERS, FRANK. Primary Carcinoma of the Gall Bladder; an analysis of twenty-three proved instances of the disease. (*Am. Jour. of Med. Science*, January, 1919.)

In reviewing 1,000 cases of proven gall bladder disease, the author found thirty-one cases of malignancy, twenty-three of which were primary neoplasms and eighteen secondarily invaded from adjacent viscera. He observed that the rate of incidence of gall bladder neoplasms is four times the frequency of primary malignancy of primary neoplasms of the appendix, and that the gall bladder is involved fifth in frequency of the organs of digestion.

It is commonly asserted that malignancy of the gall bladder is found three times oftener in females than in males, and that gall stones occur in females in the same increased proportions; hence one might infer that gall stones bear the same etiological relations to malignancy of the parts. The author found, however, in his series of primary malignancy of the gall bladder, that there were sixteen males and seven females.

Out of eleven cases examined roentgenographically, five cases showed shadows in gall bladder region, strangely suspicious of calculi. Three cases showed interference with an emptying of the stomach with a six hour retention. One case showed a filling defect at the outlet of the stomach which was interpreted as a pyloric cancer. Fluoroscopic examination was a great aid in determining that the palpable tumor lay outside of the alimentary tract. In one case the malignant gall bladder involved the hepatic flexure of the colon, with resulting colon filling defect and retardation of the colon contents caudad.

Operative findings:

(1) In four cases the malignant change was well defined and located in the fundus of the gall baldder. In two cases there were malignant papillomata. In the remaining seventeen there was extensive involvement of the entire gall bladder with invasion of adjacent viscera.

(2) Histologically the lesion was constantly carcinoma of the columnar or spirochetacell type. Sixty-nine per cent of cases showed concomitant incidence of gall stones. A large per cent of the remaining cases gave histories suggestive of calculi. The question arises: Do the gall stones, acting as a chronic irritation, produce a malignant hyperplasia of the gall bladder, or do the gall stones result as a consequence of the cancerous change altering the excretory function of the gall bladder mucosa or preventing proper emptying of the viscus?

J. H. MULLER.

WILLIAMS, A. WINKELRIED, M.B., C.M., D.P.H. The Use of Filtered *X*-rays for the Relief of Fibrous Bands and Adhesions Resulting from Bullet Wounds. (*Brit. Med. Jour.*, Dec. 2, 1916, p. 754.)

The successful use of the roentgen rays in keloid and hypertrophic skin scar suggested to the author that with the addition of filter, the same treatment might be of use in removing new fibrous tissue giving rise to trouble in deep wounds.

The same method was adopted in each case. The tubes chosen for the treatment were of

hardness seven on the Benoist scale. The rays were passed through a thin filter of aluminum 0.5 mm. A weak coil and a mercury dip break set to give 1,000 interruptions a minute, and requiring about 21,000 to 23,000 interruptions to give a Sabouraud dose of filtered rays, were used.

The details are given in four cases demonstrating the diminution of spontaneous pain and sensitiveness in the scar. We hope to hear further results of the application of *x*-rays as indicated in the title of the paper for the cases cited do not convince that there has been any marked success in the relief of fibrous tissue and adhesions although the diminution of pain and sensitiveness is definitely shown.

HAWES, JOHN B. Early Diagnosis of Pulmonary Tuberculosis. ("Medical Clinics of North America," Boston Number, January, 1918.)

The author reports cases with the diagnosis based on hemorrhage; constitutional signs and symptoms; fever and rapid pulsation; signs and symptoms referable to chest or lungs; on pleurisy with effusion. He has the following to say about the use of the roentgen ray:

"An *x*-ray examination may be of great value as an aid to diagnosis. I use the phrase 'may be of great value' advisedly. There are many hyperenthusiastic roentgenologists who claim that the *x*-ray will reveal tuberculous disease earlier and more accurately than can be done by any other method. It is undoubtedly true that the *x*-ray will reveal certain changes and abnormalities in the lung that cannot be detected in other ways, but it must always be remembered that *x*-ray evidence is based on lights and shadows, and that in most instances active and recent processes cannot be differentiated from inactive and old processes. Furthermore, the value of the *x*-ray plate, be it ever so clear and distinct, is dependent on the man who interprets the plate. It is true that the *x*-ray evidence, interpreted by an expert who recognizes the limitations as well as the possibilities of this method of diagnosis is of great value, but it is still more important to remember that such evidence should never take the place of a careful and painstaking history of the patient and the study of his constitutional symptoms and local signs in the lungs."

In a paragraph headed "Other causes of 'being run down,'" he states that any person who is in that condition runs the very serious chance of falling into the hands of some enthusiastic doctor who promptly labels him as a consumptive, and while he thinks that this condition is better than waiting for a positive sputum or other signs of the advanced stage, nevertheless it is a condition that ought not to exist.

He states, in conclusion, that the diagnosis of pulmonary tuberculosis is not an easy task; that it requires time, patience and thoroughness to make a correct diagnosis; that the patient's happiness, health and often his life depend upon the views of the physician given at this time. He concludes by saying that the "success in this field depends more on the use of common sense than on any other quality the physician may possess."

ERDMANN. J. F. Acute Diverticulitis of the Colon. (*Surg., Gynec. & Obst.*, February, 1918, Vol. XXIV, No. 2.)

The symptoms of acute diverticulitis are considered quite characteristic, but, if the symptoms are not acute, it is best to refer these patients for *x*-ray diagnosis.